

It's Raining Soldiers

POPULAR MECHANICS

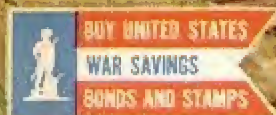
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SEE PAGE 6

"FIRSTS" A ZENITH HABIT

A GOVERNMENT official was being shown a new idea in the Zenith laboratories. In passing, he commented upon the outstanding manner in which the radio industry was effecting the rapid and continuous changes necessitated by war requirements. A Zenith official replied—he said:

"... the answer is easy. Radio and Radionics represent a trigger-quick, fast moving business. Concerns that couldn't 'change over-

night' are out. In this industry, we're used to fighting with new ideas—only—now we're fighting Japs and Germans instead of each other."

In that statement is evidenced the condition that made possible Zenith's attainment of industry leadership. Ever increasing public acceptance of Zenith name and product resulted from a never ceasing stream of Zenith "firsts"—new features—new devices and new sets which enable us to truthfully say to the public:

"ONLY ZENITH HAS THIS"

Today you find as commonplaces—essentials—of most radio sets—features first introduced to the public by Zenith—such as—

"FIRST" PUSH BUTTON TUNING

Years—yes, *years* ahead of the industry—(1928) a Zenith set embodied push button selection of the station desired. Our slogan in 1928 was "Push the button—there's your station."

For over seven years, Zenith Radio Corporation has advertised on our short wave sets—"Europe, South America or the Orient Every Day or your money back." It has never been called upon for a refund.

BELOW—A FEW NEW ZENITH "FIRSTS"—"FROZEN" BY ZENITH CHANGEOVER TO WAR PRODUCTION

"FIRST" LONG DISTANCE PUSH BUTTON PORTABLE

1942 saw the national introduction of a revolutionary new portable—the Zenith Trans-Oceanic. Without increase in size or weight it gave *push button* operation for foreign and U. S. short wave stations—tuned in the same way as locals—and standard broadcasts too. It contained a disappearing fish pole antenna plus dual Wavemagnets—operated from battery or house current—was born of Zenith pioneering in LONG DISTANCE RADIO RECEPTION.

—AND THESE ARE JUST A FEW OF THE MANY ZENITH "FIRSTS"—

"FIRST" HOUSE CURRENT SETS

"Way back when" (1926) home radios were operated from storage batteries until Zenith offered the first set run by house current.

"FIRST" SAFETY AUTO RADIO

The only auto radio you can operate WITHOUT TAKING YOUR EYES OFF THE ROAD—or—YOUR HANDS OFF THE WHEEL—the Zenith Safety Foot Control Auto Radio. This remarkable new radio was on the FORD, NASH, MERCURY, LINCOLN-ZEPHYR, HUDSON and WILLYS. Owners of these cars will gladly demonstrate their Zeniths—give you a "preview" of "tomorrow's radio today."

"MILITARY SECRET"

Today all Zenith production centers on war needs. What we are making is a military secret. But three things we can tell you. *First*... we are dealing with the thing we know—Radio—and Radionics exclusively. *Second*... we are learning every day—gaining new knowledge which will reflect itself in Zenith civilian products when the time arrives. *Third*... we now know—by first hand experience—that our Army and Navy are more than "up-to-date"—they are alert and progressive in thought and action—almost unbelievably so. This fact is a great reassurance to us here as *citizens*—it commands our complete confidence as it would yours if you knew what we know.



RADIONICS the New Miracle Industry

Four great industries are destined to lead this country back to normalcy after victory is won.

Planes and Radionics are two of the four. Radio—never a necessity on ship or train—is as essential as the engine itself to that great new form of individual and mass transportation—the airplane.

1917 WAR
RUN BY TELEPHONE

1943 WAR
RUN BY RADIO

BETTER
THAN CASH

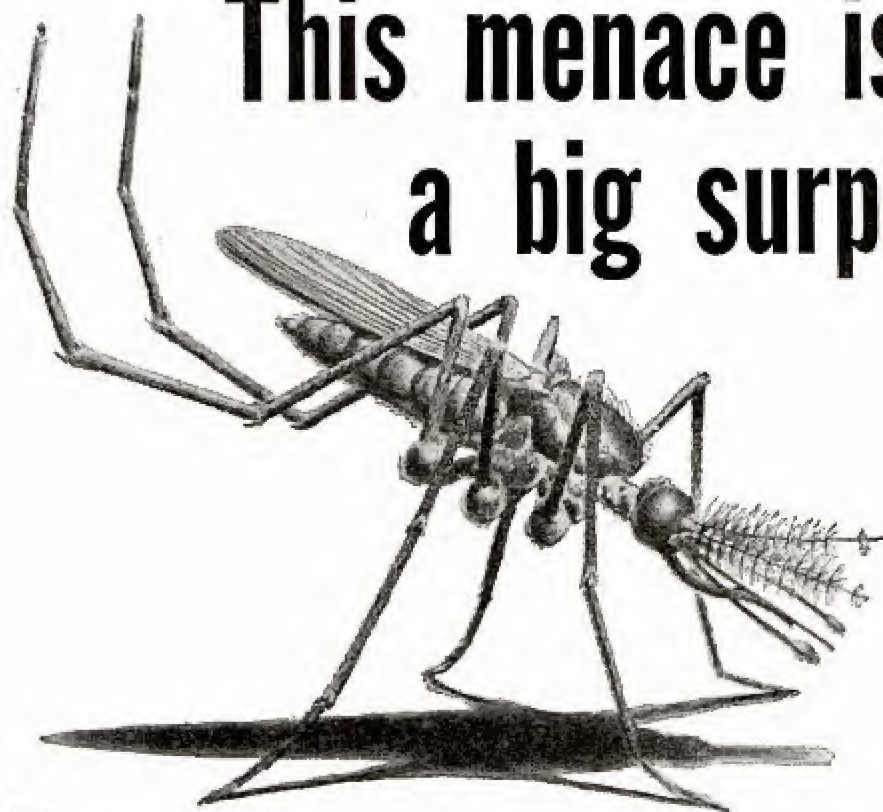
U. S. War Savings Stamps
and Bonds

ZENITH
"LONG DISTANCE" RADIO
RADIONIC PRODUCTS EXCLUSIVELY—
WORLD'S LEADING MANUFACTURER

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you is giving reliable service on
all radios—regardless of make.

ZENITH
RADIO CORPORATION
CHICAGO

This menace is in for a big surprise



Her name is *Anopheles*.

She is the mosquito that carries malaria.

From now on, she'll be much less of a menace to our fighting forces in Africa and the Pacific, and to all of us here in America... thanks to a new Westinghouse development in the field of insect control.

Insect control! Funny thing for an electrical manufacturer to be concerned with?

Not when you know that this new device—a small metal cylinder containing Aerosol, a development of the U. S. Dept. of Agriculture—was made possible by Westinghouse "know how" gained in building electric refrigerators.

With this device, soldiers in combat zones can destroy every deadly insect in barracks, dugouts, captured enemy positions, in an amazingly short time—with complete safety to themselves. Cargo and transport planes returning to America from malaria-infested areas can be rid of disease-laden insects *in flight*, long before there is any danger of bringing these unwelcome stowaways into the United States.

Is this so important? A high military authority has said that *this new Westinghouse device may save more American lives than any other single invention of the war to date.*

And it is only one of many Westinghouse products that are helping to bring Victory nearer. In addition to all the electrical products we are making—and there are literally thousands of them—we are turning out such things as precision Army binoculars, huge steam turbines and reduction gears for ships of the Navy and Merchant Marine, plastic linings for Army helmets, control pulleys for aircraft, anti-tank shot, mountings for big Navy guns.

In peacetime, our principal business is *electricity*.

But in wartime, our only business is Victory. And that means we are vitally concerned with anything—electrical or not—that our "know-how" can design or build to help win this war.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pennsylvania.

TUNE IN the Westinghouse Program starring John Charles Thomas—NBC Network, Sunday, 2:30 P. M., Eastern War Time.

Westinghouse

PLANTS IN 25 CITIES—OFFICES EVERYWHERE

This One



S4EA-R74-GTWG

"Thanks for helping"

We are grateful for your help in difficult times.

Here in the Bell System we have seen some 43,000 of our people go into the armed services.

Shortages of copper and other materials have made it impossible to add needed lines and equipment.

We have been unable to install telephones for all who want them and many of our lines are overcrowded.

Yet in spite of all this, telephone users have been tolerant and we have fewer complaints right now than at any time in the history of the business. Thanks a lot for understanding.



BELL TELEPHONE SYSTEM

**WAR CALLS
COME FIRST**



Popular Mechanics Magazine

Registered in U. S. Patent Office and Canada

H. H. WINDSOR, Founder

H. H. WINDSOR, Jr., Editor and Publisher

April, 1943

Vol. 79, No. 4

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Blasting Is Their Business

THE young engineer's job was to blow up a bridge at the last minute as enemy tanks approached. But when he made the contact with the electric exploder nothing happened. Through a hail of enemy fire he rushed to the bridge, readjusted the charge of TNT, regained his position and blew up the span. He was cited for bravery—but officers at Fort Belvoir, where U. S. Engineers are trained, tell their students he should have been censured for his mistake in setting the TNT. The first mistake is usually the last, says a May feature about the demolition school.

Paper Runs the World

WITHOUT paper, the war would end in 60 days. For it is the universal stuff of which army orders and food cartons, shell wrappings and folding money and War Bonds are made; and the recipe for a battleship calls for 37 tons of blueprints. The story of paper began in China nearly 1,900 years ago; it's brought up to date in an article scheduled for next month.

Next Month

GARDENS were a mere hobby to the average fellow a couple of years ago. Last year it was the patriotic thing. Right now it's an absolute necessity to raise your own food, for half of the entire 1943 production of canned vegetables will be needed for our soldiers and allies. And it's not a bright idea to grow enough radishes for the neighborhood in 10 days and not enough tomatoes and beans for yourself the rest of the summer. Get started right by reading: "18,000,000 Gardens for Victory," an important May article.

It Couldn't Be Done

DOUGLAS Aircraft is just one example of the miracle of American production. Its growth since the war began is fantastic. To train employees the company has a teaching staff larger than that of most universities. It spends \$15,000 a month hunting men in want ads. Its engineering department runs off 1,000 miles of blueprints a year. Next month the task this company has done is told in "The Job That Couldn't Be Done."

"Cat Crackers"

WE'RE not talking about food for the family mouser. No, cat crackers are those exclusively American industrial marvels which are producing enormous quantities of the highest-octane gasoline for our air fighters by catalytic cracking. What this means in added speed and power for our planes is told next month in "Cat Crackers—Nemesis of the Axis."

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KEEP YOUR CAR SAFE AND FOOL THE JAP

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WHERE-TO-BUY-IT INDEX

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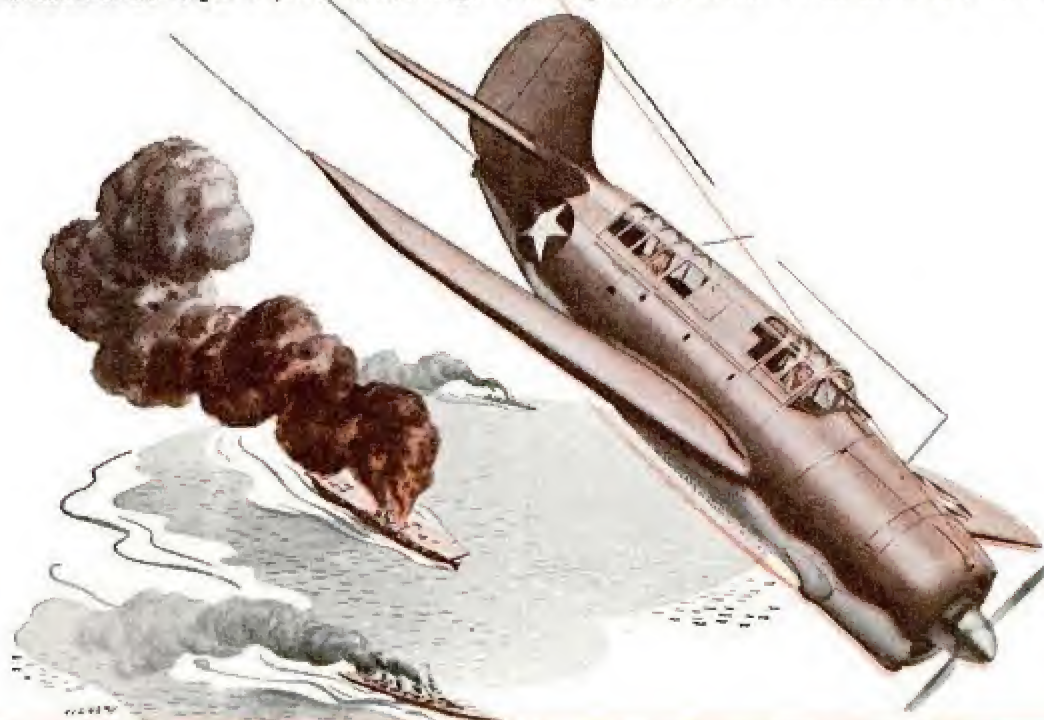
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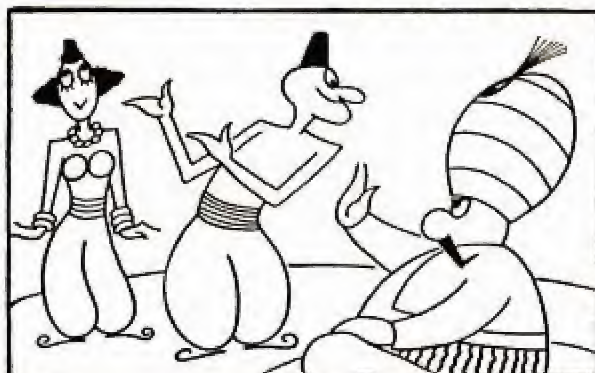
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dependable source of full, flowing engine performance, so vital to a Navy pilot at that crucial moment when an enemy ship—the never-to-be-forgotten prize—looms large in his sights. Champions are on active duty on every front.



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engines equipped with Champion Spark Plugs. In performing their vital tasks, instantaneous response to the throttle is paramount and depends on the proper functioning of the all-important spark plugs. The characteristic dependability of all Champions, including those for your car, is directly due to research, engineering and precision manufacturing unequaled in the spark plug industry.



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IMPORTANT NOTICE

It is the intention of this magazine to provide its readers with information regarding the latest developments in the mechanical arts. We take no responsibility as to whether the disclosures contained in our articles are covered by patents and advise readers to investigate this subject before making, using, or selling any of the products, machines, or processes described in order to avoid possible liability for patent infringement.



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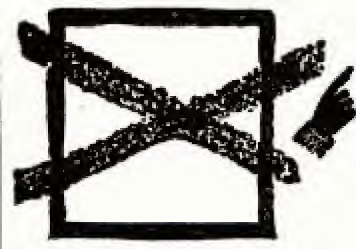
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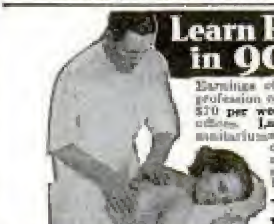
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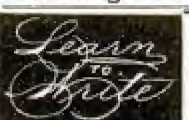


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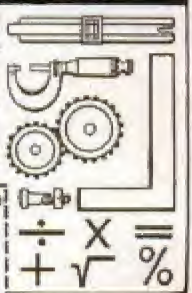
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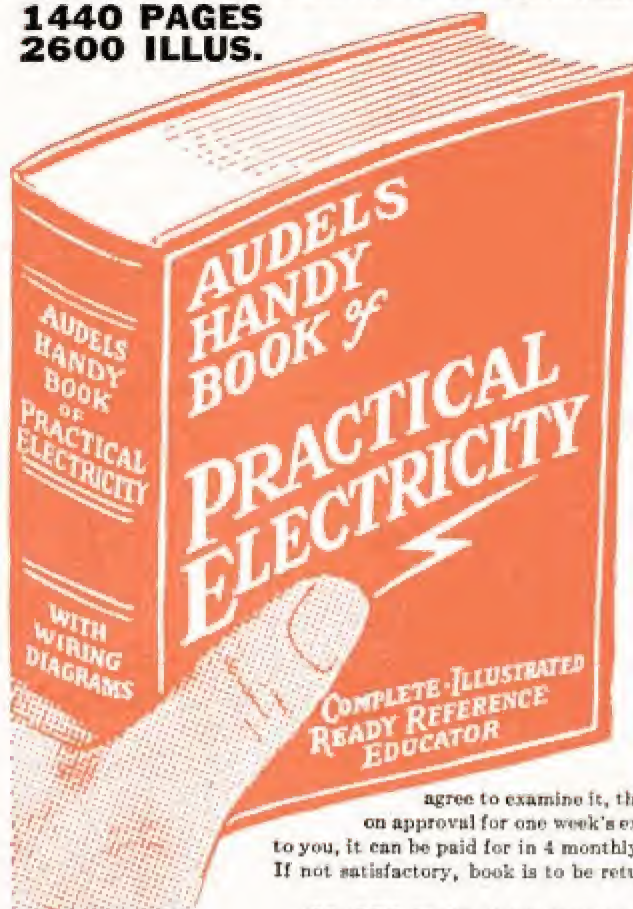
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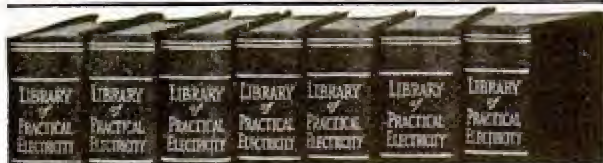
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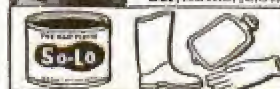
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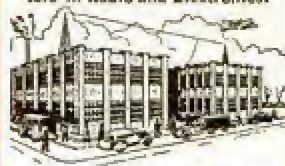
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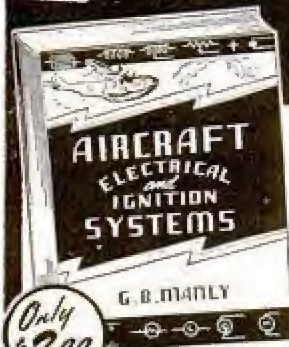
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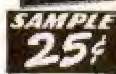
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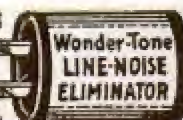
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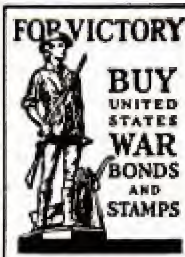
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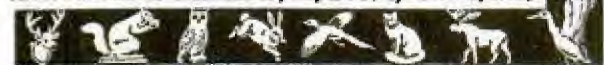


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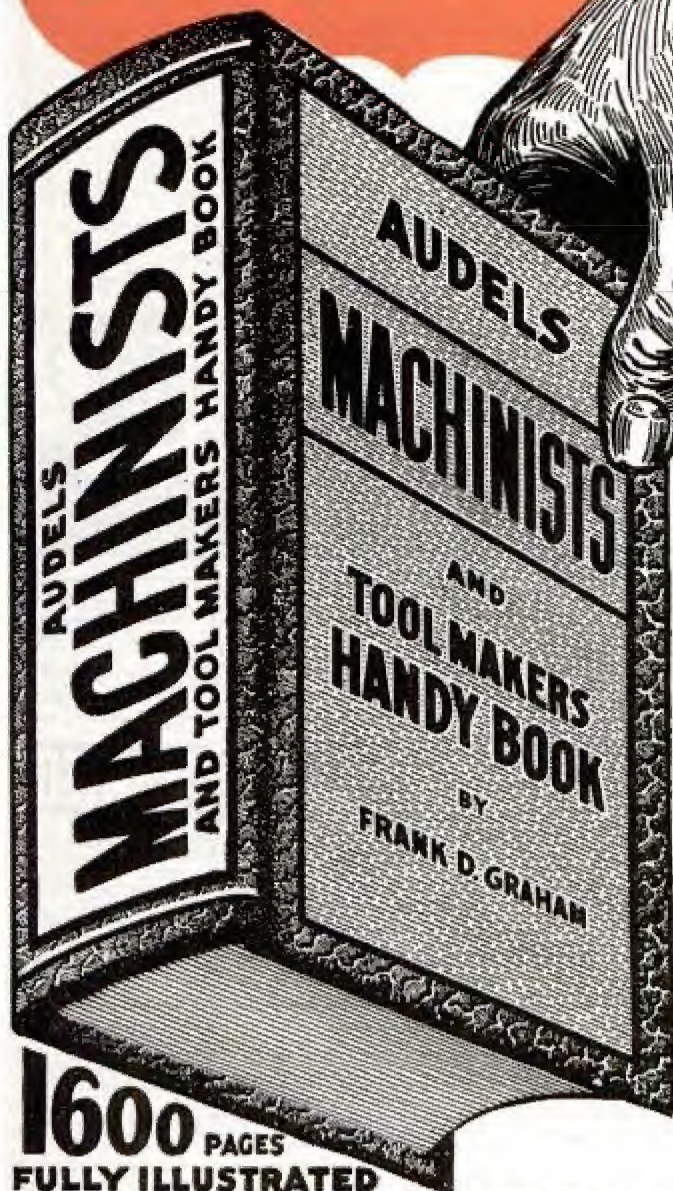
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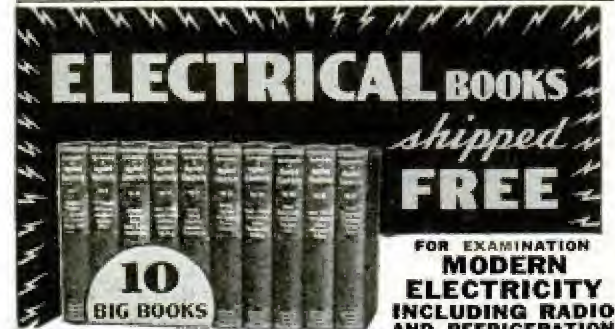
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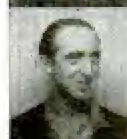
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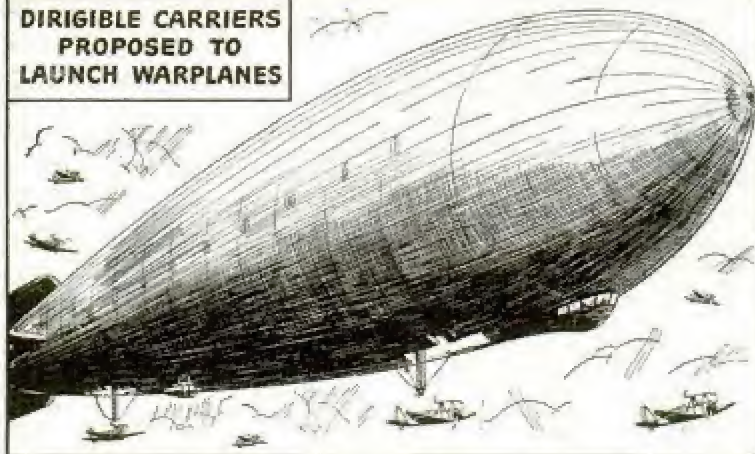
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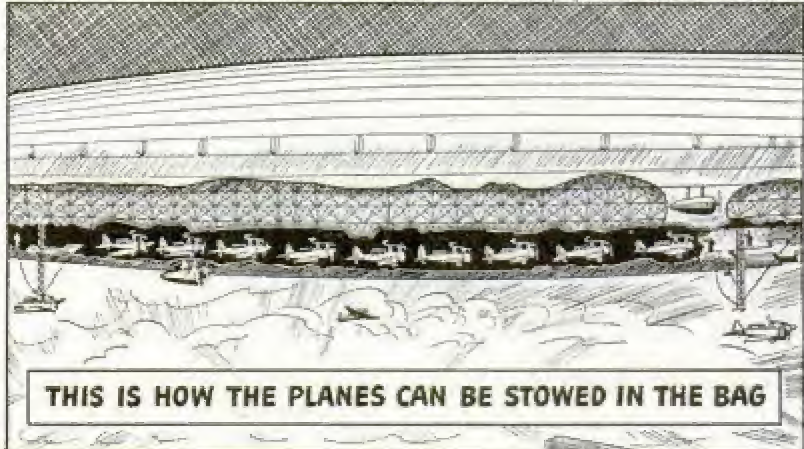
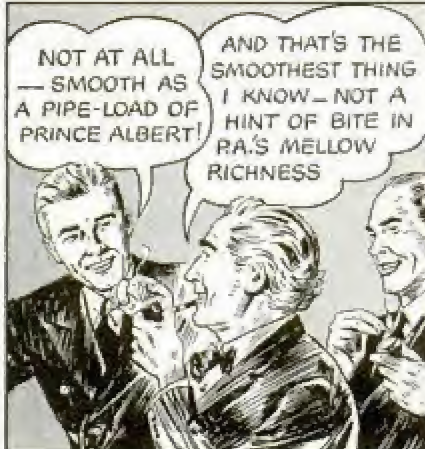
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Vol. 79

APRIL, 1943

No. 4



Above, Air Force mechanics go to school in a Buick plant. Below, counterboring stud holes in crankcase of Packard engine

THE old saying that an army travels on its stomach—that its movements are limited by its food supply lines—is only half the truth.

The modern mechanized army travels on its tool kit. Its operations are limited not by food supply problems, which have been solved by new methods of dehydration, refrigeration and scientific rations, but by its repair tools and men with the ability to use them. One damaged tank at the scene of combat, if it can be repaired, is worth a dozen new ones coming off production lines thousands of miles away.

The result is the growing trend toward sending servicemen to the production lines which turn out the machines. Soldiers, sailors, coast guardsmen, marines and air





Navy petty officers learn how armatures are wound at General Electric

corps men in uniform go to schools of production in industrial plants before departing for the firing line.

The gigantic airplane and automobile plants are being turned into new-style colleges of war. Barracks are springing up beside factory buildings. Uniformed men are drilling and toughening within earshot

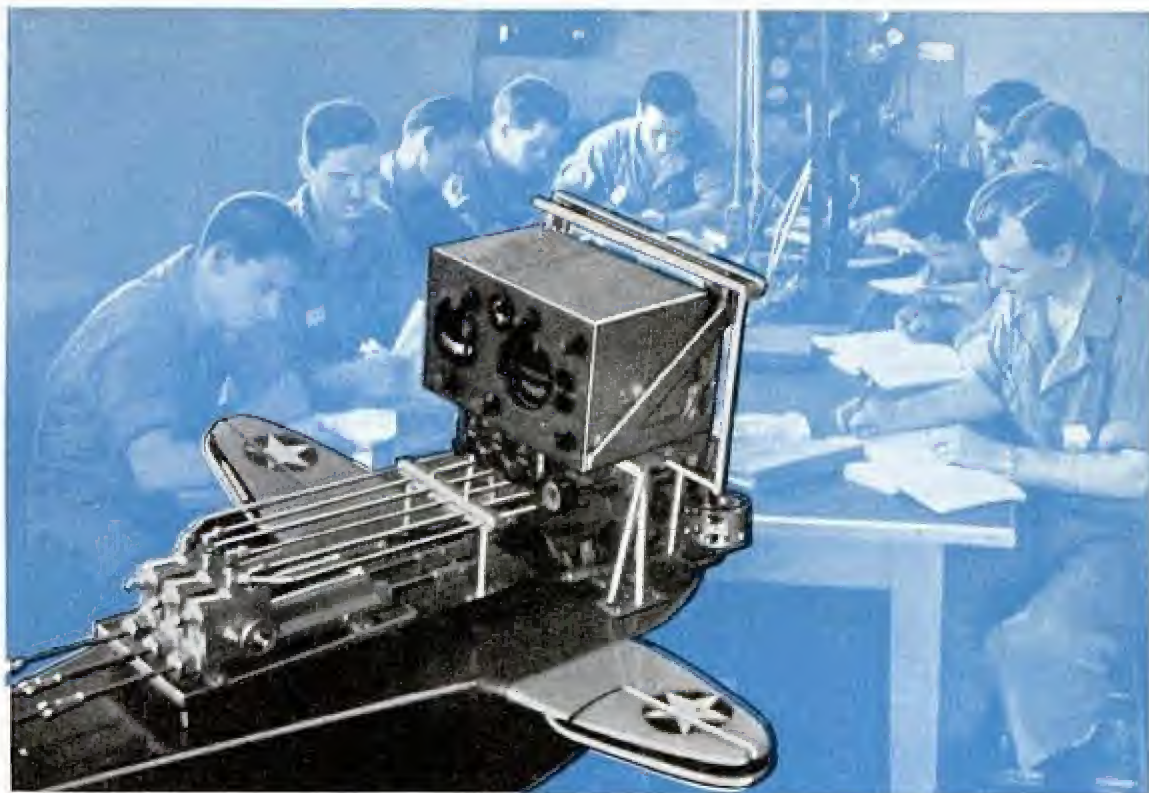
of the humming machines of mass production. Overalls and uniforms mingle at huge assembly lines as a symbol that civilians and servicemen are fighting this war shoulder to shoulder.

Hundreds of thousands of American servicemen, thousands more from Great Britain and other United Nations, will "graduate" with honor from factories this year, and many of them will serve as instructors for other servicemen at the front until, it is estimated, more than 1,000,000 Americans in uniform will get up-to-the-minute mechanical training this year.

General Electric Company was one of the first corporations to open its doors to men in uniform. Navy men are given instruction in the repair of submarine propulsion. Air men are taught maintenance of equipment for high altitude flying. Both army and navy men are learning the care

A General Electric man explains a detail of bearing construction at a school for submarine petty officers





Army mechanics at United Air Lines' Training Center at Oakland study hydraulic operation of automatic pilot

of radio equipment, searchlights, gun controls, airplane locaters and other machines the company manufactures.

Graduates of this industrial college of war are already active as far off as England, Hawaii, Africa and India, not only repairing equipment, but training new groups of servicemen in uniform. The factory training program is teaching teachers whose importance is indicated by the fact that servicemen who have completed the courses are sped to active fronts in trans-Atlantic and trans-Pacific planes.

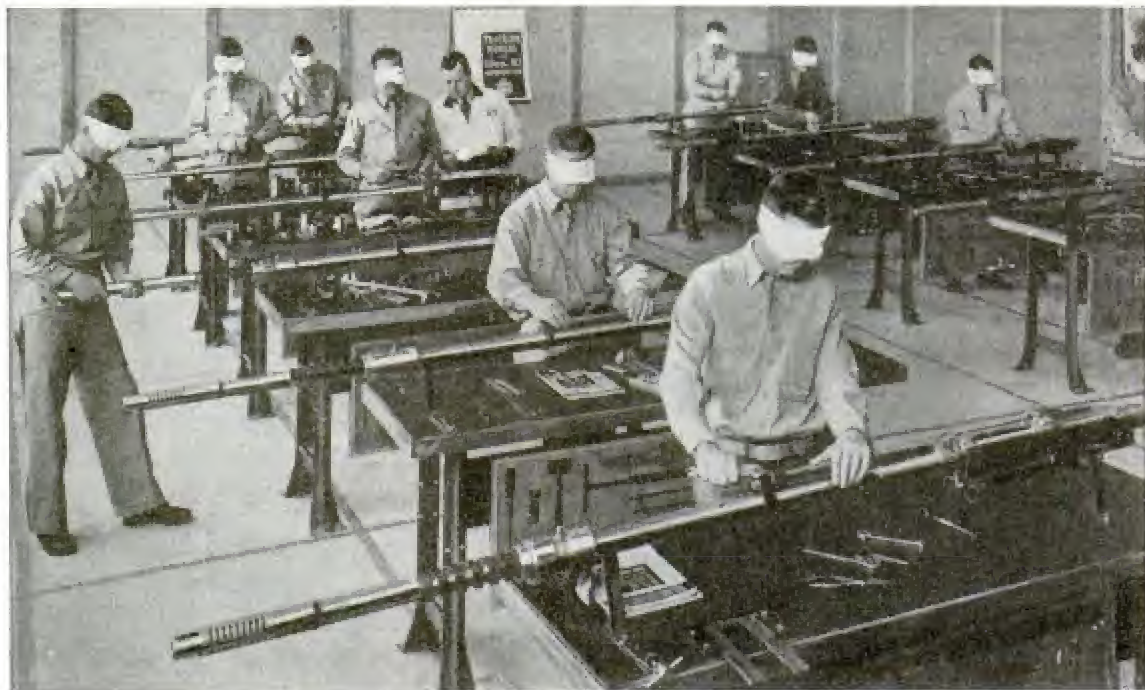
This is a war of science. Electrical machines and circuits must be co-ordinated with highly complex mechanisms, optical systems, and radio. All that has been learned in the last 20 years about electronics, frequency modulation, television, and high-frequency phenomena is now being ap-

plied to the airplane and warship. Electrification of a warship has become much more complete and complicated. Automatic controls, shockproof mounting, mine protection, radio communication, signaling, and aircraft and submarine detection require highly trained men.

The principal General Electric training courses are conducted in half a dozen of the company's plants where the products



Coast guardsmen learning to operate and maintain equipment at Westinghouse plant are shown coil system of generator stator



Blindfold assembly and disassembly of 20-mm. cannon is required for completion of Oldsmobile arms course

studied are manufactured. Smaller courses are under way at Navy yards, air fields, and aircraft factories. In space once used to store home appliances, an aircraft armament school is under way. Instruction has been given at another plant in the operation of the turbosupercharger which enables planes to maintain speed and power at high altitudes. The students learn the complete assembly and disassembly of the device studied. They are required to locate and correct faults intentionally placed in apparatus. Specially prepared texts, charts, and movies supplement oral instruction.

In Westinghouse plants, too, uniformed men of the United States, Canada and Great Britain mingle with factory workers. They attend classes six days a week, eight hours a day, working alongside the mechanics, learning to assemble and repair the company's war products. An average course runs two weeks or more. Many trainees are coast guardsmen getting first-hand knowledge of propulsion equipment before it is placed in small navy ves-

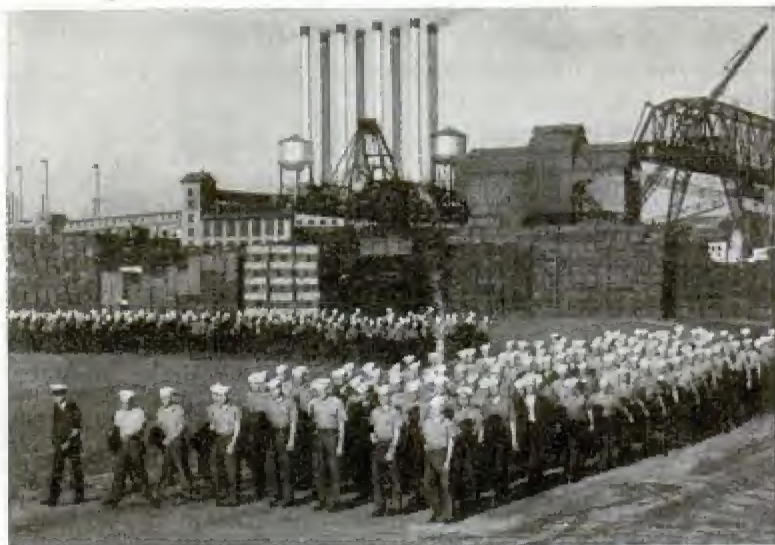
sels. This is to enable them to make repairs at sea, if necessary. Other groups include officers who are taught the assembly and care of ordnance equipment.

General Motors Corporation is "graduating" more than 500 selected servicemen a week in plants at Detroit, Lansing, Flint, Pontiac and Indianapolis. The men not only work on tanks, but on howitzers, mortars, tommy guns, planes, cannon and other weapons. At one plant, not only American uniforms are seen on assembly lines, but those of Canada, New Zealand, Great Britain, China, and Chile.

One General Motors "college of war" in

(Continued to page 168)

Navy trainees learning to service B-24 bombers march to class at the Willow Run Ford school



Army Air Forces Bombardier School, Midland, Texas

"Mikes" Score Accuracy in Bombing Practice



Aerial view of target range (above) shows how four microphones are placed in square pattern. Top left, map model of range. At left, closeup of "pillbox" for microphone

Automatic and instantaneous scoring of accuracy in bombing practice is achieved by a "sonic method" installed at the Midland Bombardier School in Texas, which transmits reports to the bomb-scoring crew 20 to 60 miles distant. Developed under the supervision of Capt. Edward Peter McKaba from a somewhat similar method used for locating underground oil deposits, this new scoring system "listens" to the exploding bombs by means of four microphones arranged in a square pattern, each being placed 500 feet from the target center. By recording the time of arrival of the sound of a bomb explosion, these microphones plot the exact spot where each bomb strikes. If, for instance, a bomb hits in the center of the target, each microphone

will receive the sound at the same time. Sound from a bomb falling off center will arrive at the nearest "mike" first, and at the others in the order of their distance from the source of the explosion. At headquarters, the bomb's position is determined by applying these values to a unique hyperbolic plotting board devised for the purpose. Heretofore, the explosion of each of the 200 bombs dropped by a cadet during his 12 weeks of training was photographed from the bombing plane. The sonic method eliminates the need for these expensive cameras and the large quantity of film as well as the labor and materials required in the process. The new system may be wired back to the home base through leased telephone lines, so each bomb can be scored the instant it hits. This also saves the necessity of making many inspection trips to the target.

Rigid, Asbestos-Protected Sheet Used in Place of Metal in Air Ducts

Heating or air-conditioning ducts and fittings made of rigid, asbestos-protected sheets are offered by a manufacturer as "a full and unlimited substitute for sheet metal." The sheets may be rolled, bent, folded, die-cut or creased on regular metal-shop equipment, manufacturers assert.

Weighing only about one-half pound per square foot, the sheet will withstand a blow of over 200 pounds per square inch. Each sheet is about $\frac{3}{16}$ inch thick. Protected on both sides by asbestos, the sheets do not rust or corrode, and are said to have high insulating value, besides resisting water.

Frank Wilson, Inc.
H.C. Wray, Chicago

Knife-Edged Streamliner Hits 100-Mile Speed



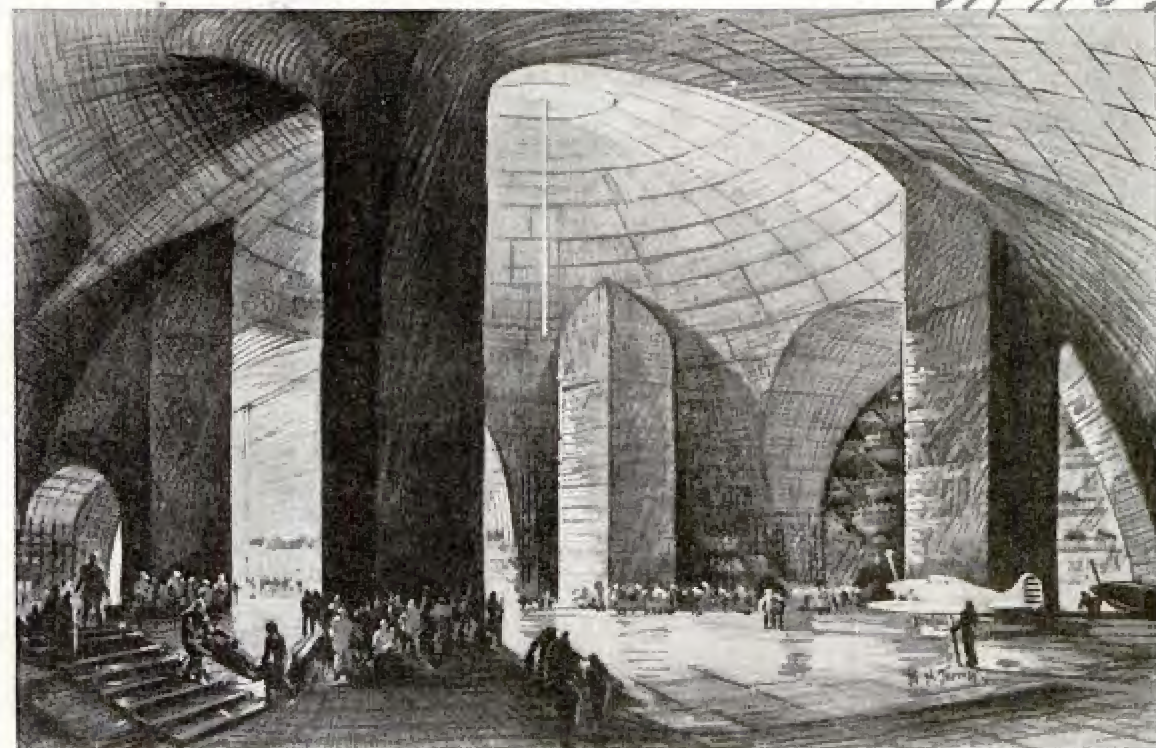
tractive force of 65,000 pounds, and one of the twins also has a booster unit which applies an additional 13,500-pound effort to the rear truck for starting. Similar in many respects to the world's largest passenger engine, the 6-4-4-6 giant which the Pennsylvania loaned for exhibit at the New York world's fair for two years before it ever saw service, the new locomotives are slightly shorter and more flexible and can be used in any part of the railroad, while the unique 6-4-4-6 is too long and rigid for the eastern mountains and curves. Both types were intended to pull heavy passenger trains at high speed

Twin steam locomotives of striking streamline design featured by knife-edge "prows" are hauling fast passenger trains over the Pennsylvania railroad between Harrisburg and Chicago. Built to make this 713-mile run with only one stop for fuel, these engines have a four-cylinder drive, with a poppet valve system, and can pull an 880-ton load—the equivalent of about 12 passenger cars—at 100 miles an hour. The vast tender carries 41 tons of coal and 19,500 gallons of water, the tanks being re-filled while running from pans between the rails. The wheels are of the 4-4-4-4 arrangement, the drivers being 80 inches in diameter. The locomotives develop a

where formerly double-headers were required. Use of the poppet valves instead of the conventional piston type permits separate control of intake and exhaust, produces greater horsepower with economy. Tests made previously with a standard Pennsylvania locomotive demonstrated that with poppet valves it could develop 44 percent more horsepower at the drawbar at 80 miles per hour than the conventional engine of the same type, and 54 percent more horsepower at 90 miles an hour. The poppet valve engine pulling a 1,000-ton train accelerated from 40 to 75 miles per hour in nearly five minutes less time than the standard locomotive.

*Acme Newspictures Inc
461 - 8av, nyc.*

Hangar Under Palisades Seen as Bomb Shelter



Chambers under deep mile and a half long tunnel would serve as air-raid shelters, hospitals and hangars

Huge bombproof tunnels dug out of the rocky palisades on the Hudson River are visualized as a possibility by George J. Atwell, who heads a construction company. He proposes a tunnel 200 feet wide, 100 feet

high and a mile and a half long. It would consist of a number of chambers serving as air-raid shelters, hospitals and airplane hangars that would be able to withstand the pounding of heavy bombs.

Silent, Non-Flashing Rifle Fires 12,000 Times a Minute

Outfiring the newest Nazi weapon four to one, an automatic, pneumatic gun developed by a Los Angeles inventor pours out 12,000 rounds a minute, compared with 3,000 a minute for Germany's latest weapon. No powder is necessary in the gun, compressed air provided by a cylinder be-

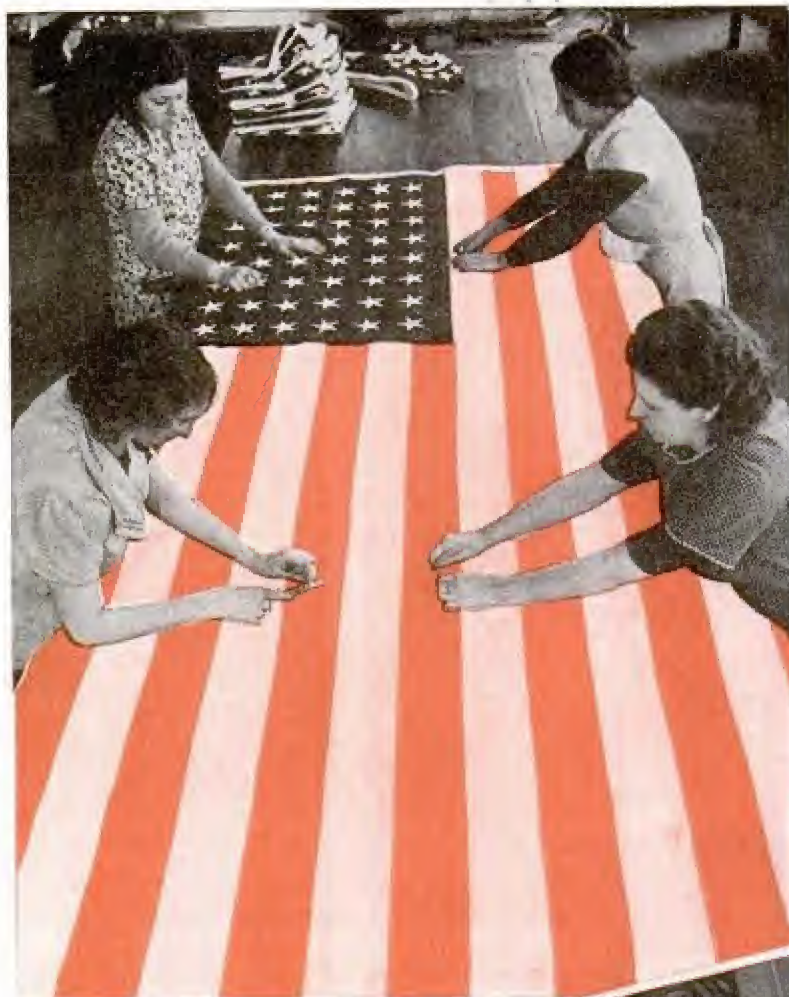
neath it supplying all the force needed to "blow" the equivalent of a .50 caliber bullet. There is no noise, no recoil and no flash, giving it special advantage for night fighting. Bullets, which require no shell casing, are fed into the firing chamber by vacuum from a hopper.



Pneumatic gun designed for night fighting requires no powder

Diesel Uses Vegetable Oil

Peanut, cottonseed, or palm oil have been found suitable for fuel in Diesel-motored trucks, and tests indicate such vehicles may burn these oils if mineral oil is not readily available. In a 300-mile road test, mileage per gallon on the regular mineral oil was 17 miles; with palm oil, 15.4 miles; peanut oil, 14.7 miles, and cottonseed oil, 14.5 miles. Mineral oil must be used for starting.



KEEPING

M1101
that manufacturing plants "down under" are fashioning cloth into the Star Spangled Banner. In parts of England it is as commonly flown as the British Royal Standard. Only one nation has suffered a major slump in the business of turning out American flags and this one is Japan, which, strange as it seems now, was America's chief competitor in making our own flags until Dec. 7, 1941.

At home, the demand for all varieties of American emblems has raised the annual flag output to

Old Glory (left) gets a final inspection on the assembly line

Below, storing printed flags in rolls to await cutter's shears



NEVER before in history have Old Glory and the other flags of the United States meant so much to so many people.

From the gray peaks of the Aleutians to the sands of Africa, the red, white and blue, together with our battle, ceremonial and signal flags, have become symbols of hope to hundreds of millions of allies, just as they are symbols of pride and confidence to Americans at home and abroad.

The result is the greatest demand for American emblems since the nation was founded—and the greatest production to keep 'em flying.

Factories have even been set up in distant lands, particularly those of the British Empire, to manufacture American flags—places where the flags were seldom seen in pre-war days.

Such far off continents as Australia will celebrate United States flag day in June and so great is the popularity of our flag

the almost incredible figure of 30,000,000.

Textiles for flag manufacture have as high a priority rating as many essential war products. Approximately 25,000,000 square yards of fabrics have been allocated per year to flag manufacture, including not only the Stars and Stripes, but service flags, marine signals, flags of other members of the United Nations, flags of states and mu-

Allen Warren Elliott
7 Park Ave. N.Y.C.

'EM FLYING

nicipalities and insignia used by civilian defense organizations. Despite the fact that many new companies are manufacturing flags, deliveries are five weeks to three months behind orders.

The largest flag concern in the world, Annin and Company in New York City, finds that even with the huge increase due to the expansion of our armed forces, the American public is by far the biggest buyer. On the order books of this company, which is typical of the industry, the patriotic demand of the American public

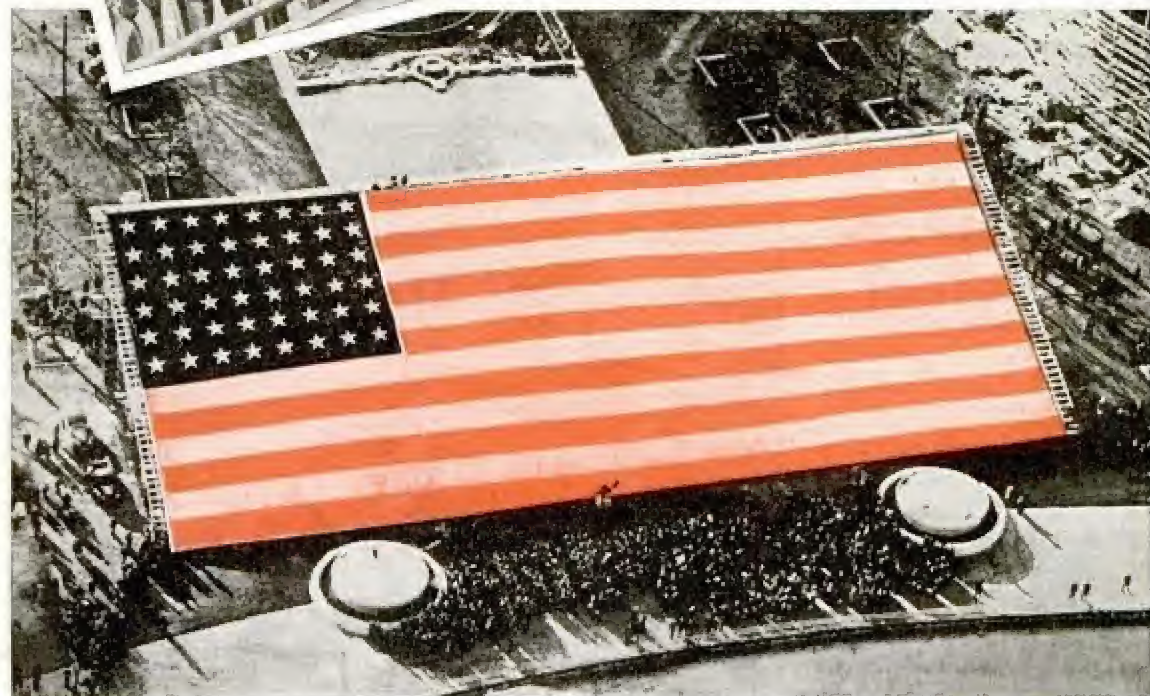


Courtesy Annin & Co.

† While she sews, flag-maker is careful not to let flag touch the bare floor

Left, signalman on ship prepares to hoist a flag—flags on board total 200

Giant flag (below) used for civic celebration at Verona, N. J., never flown





Soldiers at Fort Sam Houston stand at attention during flag-raising ceremony—for outdoor use flags are made of wool and silk to resist weather

ranks first in volume, the army second, the coast guard third, the navy fourth, the maritime commission fifth with demand for service-star flags and "E" flags making up the balance.

The red, white and blue furnishes all but a fraction of the number of flags made for the public and the army. The navy, coast guard and maritime commission also place large orders for signal flags and flags of friendly foreign nations, a total of some 200 of which are stowed aboard nearly every American ship.

Cotton and rayon are used for the bulk of the civilian flags, with rayon more or less limited to indoor or sheltered use. For all army and navy uses which require exposure to wind, rain and sun, wool and silk are necessary.

Even silk and wool flags are often whipped into tatters during a single cruise of a ship which meets bad weather. This requires constant replacements of badly damaged flags. These are never merely discarded, but are always burned. The American flag never

Joining blue field to stripes on an army flag made at the Philadelphia Quartermaster Depot

finds its way into the garbage heap.

Colors most often used in flag making are white and red because they go into the stripes and stars, with blue third. Yellow and black come next in demand.

The Stars and Stripes, the proper name for which is the United States Ensign, fits well into mass production methods in the popular sizes, but flags for the President, cabinet officers, army and navy commanders, regiments and battalions, the states and municipalities and foreign banners must be fashioned by experts in

an operation much like hand tailoring.

The slightest error becomes a glaring fault in the eyes of those who pledge allegiance to a flag. In South America, where the United States has displaced Germany in the flag business, a small mistake even in proportion would be viewed as an insult.

In the case of the cheaper and smaller American flags, the stars and stripes and fields of blue are printed on long strips of cotton and rayon which run through presses not unlike those used to print wallpaper. The ink, or dye, is dried and the strips are wrapped into rolls in which



form they are stored. The flags are hemmed and cut off one by one as needed.

For larger and more expensive flags, rolls of red and white material are sliced into strips of the correct dimensions. The stripes are then sewn together by expert seamstresses. White stars are stamped out, usually with blunt points to be trimmed later, attached to blue fields and then the flag is assembled. It is given a canvas binding through which eyelets, called grommets, are punched to hold the rope or halyard.

To make stars, as many as 125 thicknesses of cloth are placed on a press so that a single die, directed by hand, punches through all of the layers of cloth at each stroke of the machine. One man can turn out thousands in a day.

The army and navy, which make most, but not all of their own flags, manufacture none of the printed flags which private companies turn out by the mile. While they use machines to cut out stripes, punch stars and sew, the work is of a highly specialized type requiring much instruction and long practice to keep pace with production lines. These lines, in the case of the navy plant in Brooklyn Navy Yard, the largest operated by the government, turn out one variety of precision-made U. S. emblems at a flag-a-minute clip. Altogether this Brooklyn loft turns out about 200 types of flags.

The largest army flag-making unit in the Phila-

(Continued to page 166)



† Miles of flags are made in strips and then hemmed and cut off. They are printed on cotton and rayon on presses like those used to print wallpaper



Worker painting figures on state flags—New York, left, California, right

"Star maker" (below) stamps out stars which are trimmed to point by hand



FLYING FERRY



Electric "Ear" Tests Gasoline for Anti-Knock Quality

All guesswork in measuring the efficiency or octane rating of gasoline can be eliminated by using an electronic method that "listens" to the "knock" while an engine is running under test. Three instruments work together in analyzing the knock. First is a sound pickup that plugs into the engine by means of a cable. It "hears" two noises—the main explosion and the knock. The second is a sound filter whose job is to tune out the sound of the main explosion and feed only the knock noise into the third instrument—the cathode-ray oscillograph—which shows a wave

form on a screen corresponding to the intensity of the knock. The height of the cathode-ray wave form or deflection is noted when testing a standard octane rating gasoline, and then the unknown gasoline is substituted and adjustments are made on the engine to obtain again the same height of cathode-ray deflection. The engineer, by taking careful note of the engine adjustments, can determine immediately the octane rating of the unknown gasoline. Engineers can also rid an airplane engine of all knock with the aid of this instrument.

*Intel News Photos, 326 W
Madison, Chicago*
for TANKS
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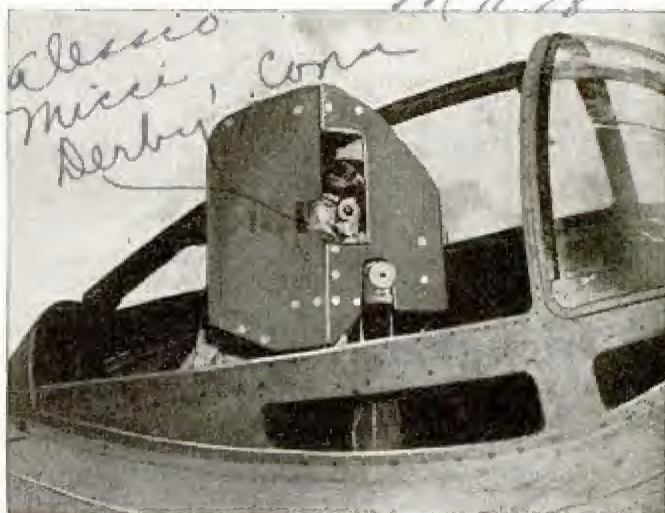
Burbank
Combining high speed, long range and cargo capacity, Lockheed's "Constellation" transport plane can outspeed a Jap Zero or any four-motored bomber now in action, though it's the largest cargo plane in production. It is capable of ferrying across the ocean a light tank and its complement of men, or the equivalent weight in men and cargo. Designed as a peacetime transport for T.W.A., it can carry 55 passengers and a crew of nine nonstop from Los Angeles to New York, its makers assert. Its speed across the continent would be 9 hours; and it could make Honolulu in 12. Fully load-

ed, it uses only one gallon of gasoline a mile for its four 2,000-horsepower Cyclone 18's, which their manufacturer, Wright, calls the world's most powerful service engines. The "Constellation" cruises "above the weather" at 20,000 feet, but can rise to 35,000 and still maintain air density of the 8,000-foot level within its pressurized cabin. It can remain at 25,000 feet on three engines, and at 16,500 on only two. Exhaust heat from the motors de-ices the wings. Engines can be reached in flight through a passage in the wings, and can be removed and replaced in 45 minutes.

Armor Plate Protects Gunner in Bomber "Greenhouse"

Stationed in an exposed position where he would make an easy target for enemy fighter planes, the gunner in the blister turret of a PBY patrol bomber is protected from bullets by a special shield of heavy armor plate. One of a crew of eight aboard the long range raider, the aerial marksman aims his .50 caliber machine gun through a telescopic sight.

Write to the firms listed in the Where-to-Buy-It Index, to learn more about products described in this magazine. Say You Saw It in Popular Mechanics.



Twentieth century knight carries shield in turret of bomber

Allen Warren Elliott, 7 Park Ave, N.Y.C.



You'd never recognize it, but the neat bed-tray (left) is a converted orange crate, sides torn off. Right, easing foot pains by binding pillow so the patient has something firm to press against



m 1128
KEEP the PATIENT

Ingenuity on the part of home nurses trained by American Red Cross makes up for shortage of registered nurses and sickroom materials. Among innovations are wood blocks (left) converting low bed into high hospital cot. Below, the bridge table is used to make a canopy for treating the patient with inhalants





COMFORTABLE



Three pieces of wire and wood (right) used to protect sore foot from sheet

Below, sheet tied around end of bed enables patient to pull herself up

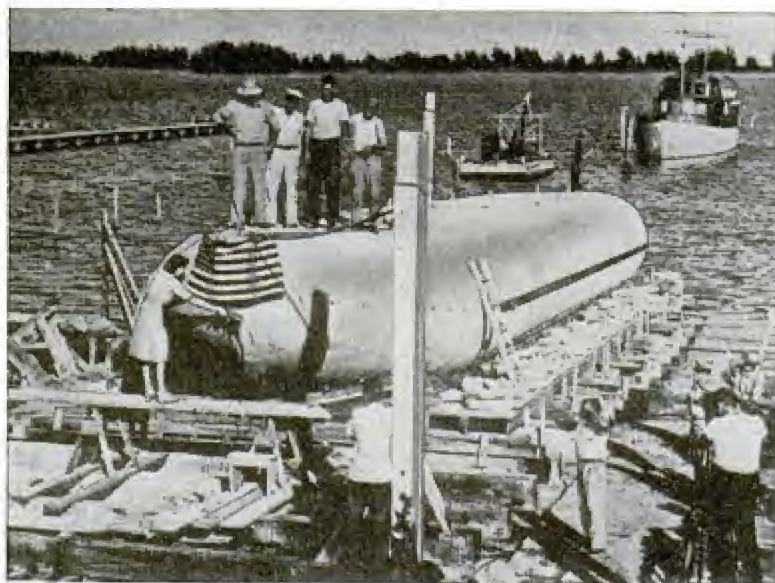
† Chair transforms ordinary bed into hospital type to support patient in reclining position. This is especially handy at mealtime

Paper bag (below) with hole for the nose makes an excellent croup tent. It covers pitcher of steaming fluid set in pan for safety



Intl News Photos 326 W Madison, Chicago

"Phantom" Convoy Vessel Has Remote Control



7/1/85
Called a phantom of the seas because it runs without a crew, a concrete vessel for convoy service operates by remote radio control from a master escorting vessel. Without the deckhouse, which is merely a temporary structure, the ship lies low in the water, making it difficult to sight from a submarine and to sink. Built in full size it will have a cargo capacity of 2,000 tons, being 260 feet long, 36 feet at the beam and 27 feet in depth. Ten or more can be operated from a single control station, and should one be destroyed by the enemy its loss would be comparatively small.

Top, launching a 90-foot model of vessel designed to travel in convoys operated by remote control. Left, boat on trial run has temporary deckhouse

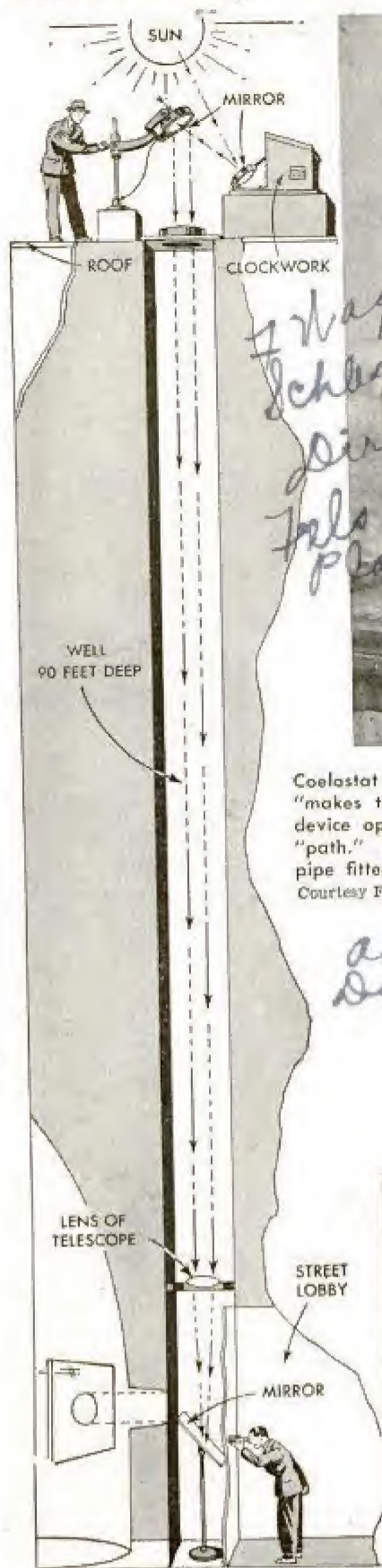
Big-Scale Globe Helps President Mark Arenas of War

Presented by the U. S. Army, a huge world globe, 50 inches in diameter, aids the President in locating fighting fronts quickly. It occupies a prominent place in the Presidential offices in the White House.

Even from a distance of several feet, the 50-inch globe in the President's office in the White House has details of war fronts



Ref: Fels Planetarium *The Franklin Inst, Philadelphia* **Mirrors Pipe the Sun to "Lab" 90 Feet Below**



Coelostat on roof of the planetarium (above) "makes the sun stand still" with clockwork device operating mirrors following the sun's "path." Image is carried through a 90-foot pipe fitted with lens as shown in the sketch
 Courtesy Fels Planetarium

I.M. Levitt
asst. Dir.



Left, using eyepiece of "stove pipe" telescope to study the sun in lieu of screen (above) at the Fels Planetarium, Franklin Institute, Philadelphia. For study by large groups of astronomy students, sun's image is projected on wall on which are drawn stars invisible in daytime. Navigation students can learn to "shoot" the sun indoors and speed wartime training

Camera Atop Car Shoots Wild Horse Stampede

m 1176



Keeping pace with wild horses, tanks, or planes taking off is no job at all for the camera car (left) that can shoot a scene while speeding at 70 miles an hour over rough terrain. The car is equipped with two sets of springs to hold even keel on the camera mounts and wheels have two shock absorbers. Generating units provide electricity to run six cameras and a battery of movie lights



Young admirer looks on while car inventor, P. J. Grosso of Hollywood, operates hydraulic pump which controls auxiliary springs. Right, rear view of car shows various levels for mounting cameras in addition to top, front and side platforms. Below, the car gets a test shooting a wild horse stampede in "The Desperadoes"



5509 Klumpfen
N. Valleywood, Cal

Photo
P. J. Grosso

IT'S RAINING SOLDIERS

m 85-1



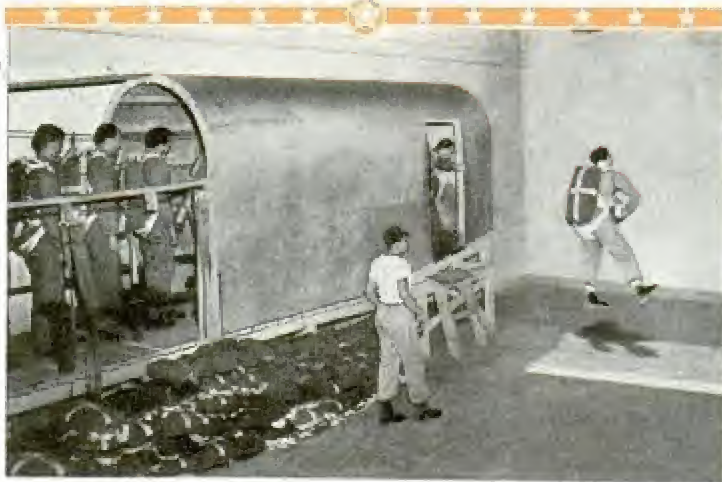
The rain begins! Over Africa and New Guinea and the Solomon Islands, Yankee paratroopers like this man are pouring out of the skies to establish advance footholds for the ground forces and seize air bases

22007 ar Wells ave
By Julian P. Leggett
Oakwood
Dayton, O.
 Major, Air Corps

WHEN American parachute troopers "hit the silk" and floated to earth, then seized important airfields in North Africa a short time ago, military experts sat back and said, "I told you so."

For these experts, including commanding generals of various divisions of the Army Air Forces, had predicted that one of Uncle Sam's most powerful striking forces would be an air-borne army. And the invasion of Africa provided the occasion for the first real test of this force.

Not too many details of the North African campaign have been revealed, but hints of the paratroopers' role in the swift advance from the coast to the very gates of the Axis' last stronghold on that continent have appeared from time to time in com-



Looks easy—and at this stage, it is. Before a parachutist makes his first real jump, he goes through all the motions in a four-foot leap from the open door of a "mock-up" of a transport plane



This is how a glider pilot cuts loose from his tractor plane, releasing the tow line when his craft is ready for a glide to earth. Below, beginners get the feel of parachute and harness before they start the rigorous aerial course at Fort Benning, Ga.



muniques. Right from the start, it is evident, the paratroopers leaped from aircraft and quickly encircled a number of landing fields from which the defenders might have launched warplanes. So rapidly did these Yankee "Commandos of the sky," working in conjunction with the British, perform their missions, not a single defending plane rose from the ground. The paratroopers landed from their carrier planes, assembled their weapons and attacked "on the double." With the airport in their hands, the Yankee and British forces then waited until fighter and bomber aircraft began to land and ground troops moved up to relieve the paratroopers.

In the same manner, the paratroopers are employed in the seizure of important objectives behind the enemy lines. Dropped from the sky in advance of the Allies' ground forces, they can surprise a small defending unit, then hang on to the objective until their own men arrive.

Many details must be kept secret concerning the exact size, composition, tactics and objectives of these commandos of the sky, but it is a safe guess that many an American attack in the next few months will find them leading the way. Further, it can be told that in size, equipment and firepower, this airborne army ultimately will exceed anything of the kind that the world has ever seen.

This army-on-wings includes more than paratroopers. According to General Henry H. Arnold, Commanding General, Army Air Forces, it eventually will be composed of glider pilots and combat troops transported by aircraft, both airplanes and large gliders, as well as the already famous parachute

soldiers. It is contemplated that the paratroopers frequently will be transported in large airplanes which will tow troop- and equipment-carrying gliders in battle areas.

In announcing formation of the air-borne force not long ago, General Arnold said:

"Glider pilots and air-borne combat troops will be in the forefront of attacks; the importance of these swiftly moving fighting teams cannot be over-estimated. This will be a self-contained force whose soldiers, equipment and supplies all are transported by air. It will be able to strike the enemy where he is least prepared."

Tactical training of the aerial commandos for lightning offensive action has been in progress for many months at a number of stations, which were set up to augment preliminary and advanced glider pilot schools and paratroop training establishments. Upon graduation, the new glider pilots join other units of the air-borne army forces at the tactical stations to com-



Marine paratroopers training at a Naval Air Station hook ripcords to cable and are ready for the plunge

Three big army transport planes pour out chutists in an aerial parade, precise as if hung from one string



One a second, they pour into the sky while the jump-master stands by watchfully. Boots of one paratrooper are still visible outside the door as the next man is halfway out. Notice ripcords still attached to cable



The Yankee Commandos of the air are forming a huge glider army, too. Here airborne troops leap from glider to attack

Reactions of student paratrooper are tested on tower from which jumper falls for 20 feet before harness checks him



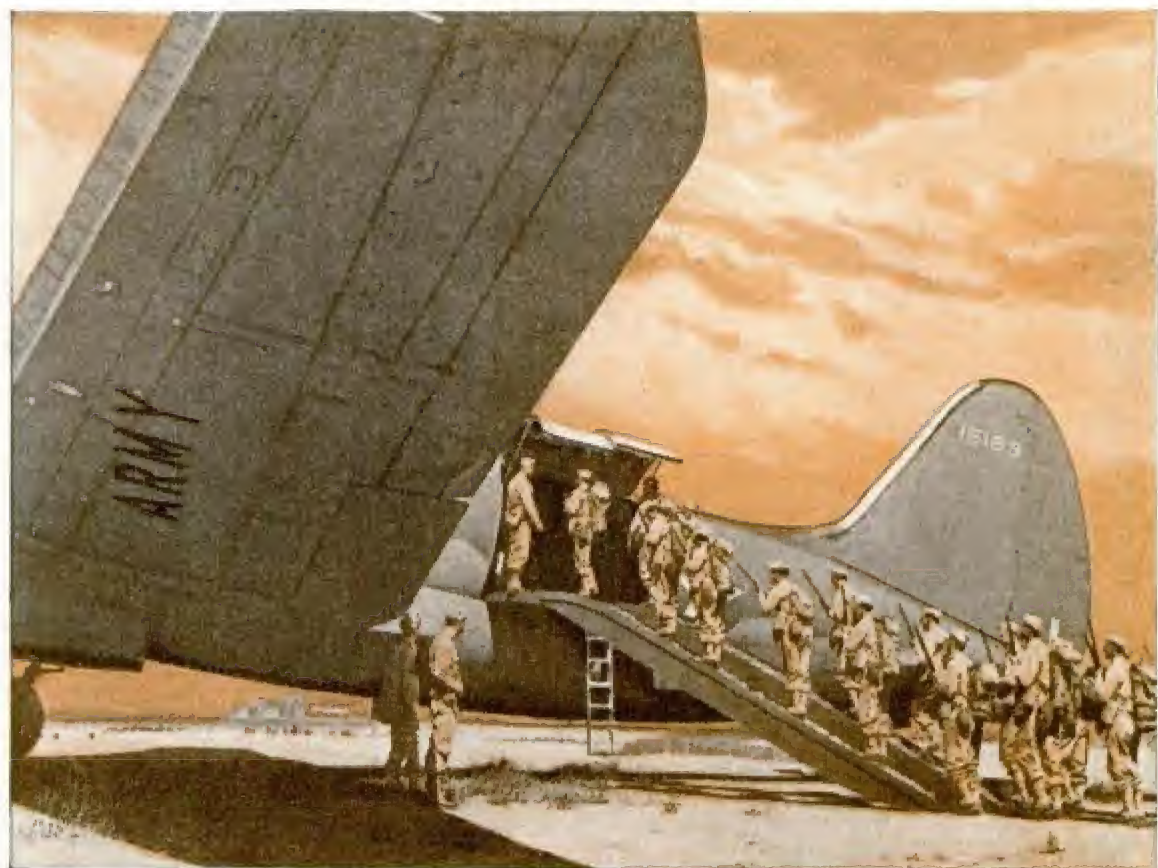
plete their training coordination with the combat groups.

When formation of this force was first announced, two complete airborne divisions had been organized. These air units included parachutists, transport-borne troops and glider-riding soldiers — all formed into a powerful striking force similar to the infantry and with approximately the same fire power.

Of the various phases of this program, which has progressed with even greater speed than its creators had anticipated, the glider development is the newest, as well as the fastest-moving. Not many months ago, the glider had no place in the American air forces; few glider pilots were to be found among the nation's flying officers. But the picture has changed at a dizzy rate. Its outlines had been laid prior to the Pearl Harbor attack by the Japanese and today every detail is in sharp focus. Hundreds of pilots have been trained and hundreds more are in training; many gliders have been built and hundreds more are in the building. Even the actual size of the glider has been increasing. First, there were only one- and two-



Parachutes are still billowing on the ground as the troopers from the sky consolidate quickly into fighting teams, seize the equipment and supplies dropped with them, and rush into position. Below, airborne infantry march up the ramp to board a Curtiss "Commando," the C-46. This twin-engine cargo plane is one of the largest aircraft in the world, being mass-produced for the Army Air Forces for transport service





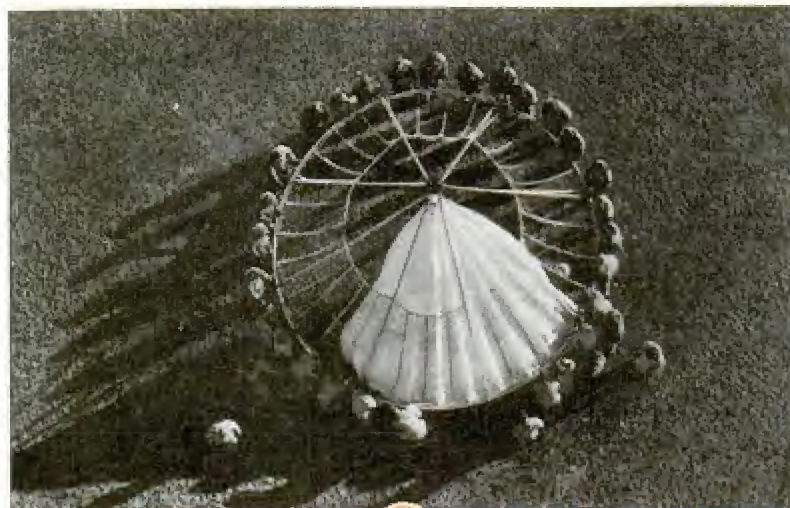
Marines watch the terrain as they come in for a landing. Their transport plane carries a new type midget car and a 37-millimeter antitank gun

purposes. Next came a glider capable of carrying nine fighting men of average weight; needless to say, it could be employed to advantage in transporting soldiers. Latest of the gliders to be announced is a 15-place ship; not only will it carry 15 aerial Commandos, but its weight-carrying ability is sufficient for transporting certain equipment as well.

And beyond the 15-place glider probably are ships of still greater capacity. Dispatches from the fighting fronts have told of German gliders large enough to transport "baby" tanks, five- or six-ton machines, in all likelihood. American engineers have not even hinted that any of their efforts may be pointed in this direction; the practicability of moving tanks of any size by this means may be questioned.

tion a bit to realize the usefulness of such a development. It can be accomplished by a hook, which extends from the airplane in a downward direction, for engaging a pick-up device, similar to that used in airplane mail pickup service. Attached to the pick-up device is the tow line of the glider. Making the connection and hauling the glider into the air is only a matter of seconds, in contrast to the amount of time required for landing the plane, making the tow line connection and then getting both the airplane and the glider into the air. Too frequently, there is insufficient space for an airplane to land or take off, yet enough for the glider to be lifted into the air by means of this pickup system.

Of more appeal to the imagination of the layman is the parachutist's role in the aerial Commando force. Youth's never-ending quest for thrills is fully satisfied in the paratrooper's daily routine. Using newly developed equipment and launching technique, the 'chute troops drop from carrier aircraft at a rate of one per second; then additional supplies of ammunition, guns, food and water can be dropped at will in aerial delivery



A circle of parachute students hook on to the practice "flyaway" chute at naval air station

containers developed and tested at Wright Field. Leaping, one after another, in a form of split-second aerial marching, the paratroopers land with almost uncanny precision on a predetermined area adjacent to a military objective. Often this is accomplished with no more than a few hundred feet of altitude in which to clear the carrier plane, open the 'chutes fully and maneuver them to the landing area.

Speed, surprise and controlled mobility are attained only after long, hard periods of practice formation jumps with full field equipment. After a period of learning how to pack his own parachute—highly important because his very life depends upon his skill—the student is physically conditioned for the rough-and-tumble work of parachute jumping. He is given 30 minutes of "double time"—twice the regular marching rate—each day, plus morning exercises which strengthen and toughen him for the job ahead. Next he places a dummy parachute on his back, to get the feel of it, and practices "landing" from a dummy airplane on the ground; he slides down an inclined beam on a suspended harness which releases him above the ground, thus accustoming him to landing from a height. Next, the student learns to tumble and fall correctly so as to avoid fractures or sprains; also how to come to his feet instantly after landing. He climbs ropes hand-over-hand and is taught balance and coordination.

Tower training is the next phase and here the student's reaction to "falling free" through the air for 20 feet are noted before he is allowed to descend from a 250-foot tower. First, he makes a controlled jump, with wires guiding his 'chute safely to earth, and then a "free" jump, in which the 'chute floats to earth with no control other than the student's manipulation of the shroud lines.

The fourth, and final phase is actual jumping. The student makes five classifi-



Signaling with the "biscuit gun" at a glider school

cation jumps and must participate in at least two mass jumps of 12 men each. During this phase, the men are graded on their work. If the student declines to go aloft or to jump, he is disqualified. The paratroopers are volunteers.

Of his work a paratroop officer said recently:

"In our Army, a parachutist is not one who merely parachutes. Parachuting is a great sport. The tedious preparation pre-



The dragline from a tractor plane has hooked a towline and in a few seconds will pull glider into air



in contrast, they devoured oranges and cookies, cracked jokes and ribbed one or two of their group about landing on tree stumps or in a lake.

This same group had double-timed for two miles the day before in a bit of "warming up." And the day before that, they had marched 35 miles in less than eight hours at night under blackout conditions while carrying complete equipment.

Jumping from their aircraft and landing in a particular area is far from being the paratrooper's entire job. They are specialists of the first order, being trained in aerial photography, map reading, radio communication, compass orientation and the use of virtually every type of weapon, from the Garand automatic rifle to the trench mortar. And they know how to use some new—and still secret—weapons.

Being of the Commando type, the paratrooper also is taught how to operate all kinds of vehicles—armored equipment, trucks and motorcycles—as well as railroad trains. Such knowledge may be highly valuable in enemy territory. All this training, plus careful planning of each particular mission, makes the paratrooper one of the deadliest fighting men on earth.

Then there are the air-borne troops in this aerial striking force. They are transported to destination by glider and airplane, following closely on the heels of the paratroopers whose job it is to seize an airport where the aircraft may land. Their training is directed upon the importance of swift loading and unloading of their planes. One of the latest airplanes useful for this purpose is the Curtiss C-46, the Commando, which is capable of carrying some 50 men with full equipment. The Commando has a wide side door through which a jeep or a large gun can be loaded.

This, then, is the force which our military experts are confident will prove one of the most important in America's scheme of attack leading to victory.

Ceramic Grates Save Cast Iron

Although new cast-iron grates are banned for the duration, flames will continue to flicker in American fireplaces because of ceramic grates now available. These nonmetallic grates, developed from clays, and other heat-resistant materials fired and hardened at extremely high temperatures, will save 30,000 tons of cast iron.

APRIL, 1943

Strand Ski Co New Richmond, Wis. Sled With Ski-Like Runners Glides on Ice or Snow

m 11/63



Ski-like runners slide easily over snow, sleet or ice

Ski-runners have been found to be a welcome substitute for metal on children's sleds, as they give the gliding effect of skis and bring the thrills of coasting to areas of the country where metal runners are not practical. Treated with a special ski wax, the sled is said to ride straight and true over light or deep snow, sleet or ice, and it is easy to pull over deep snow even when it is heavily loaded.

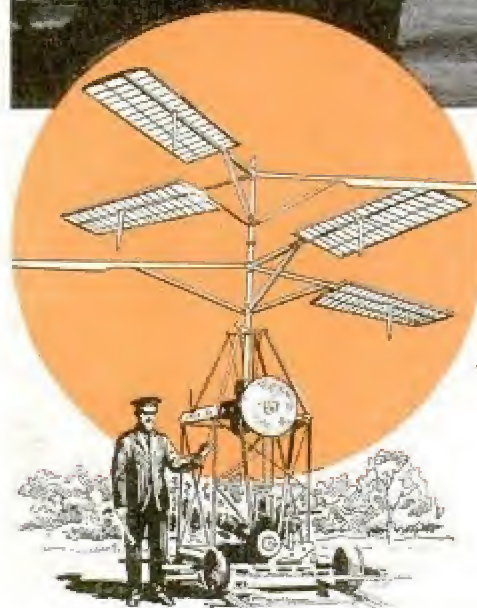
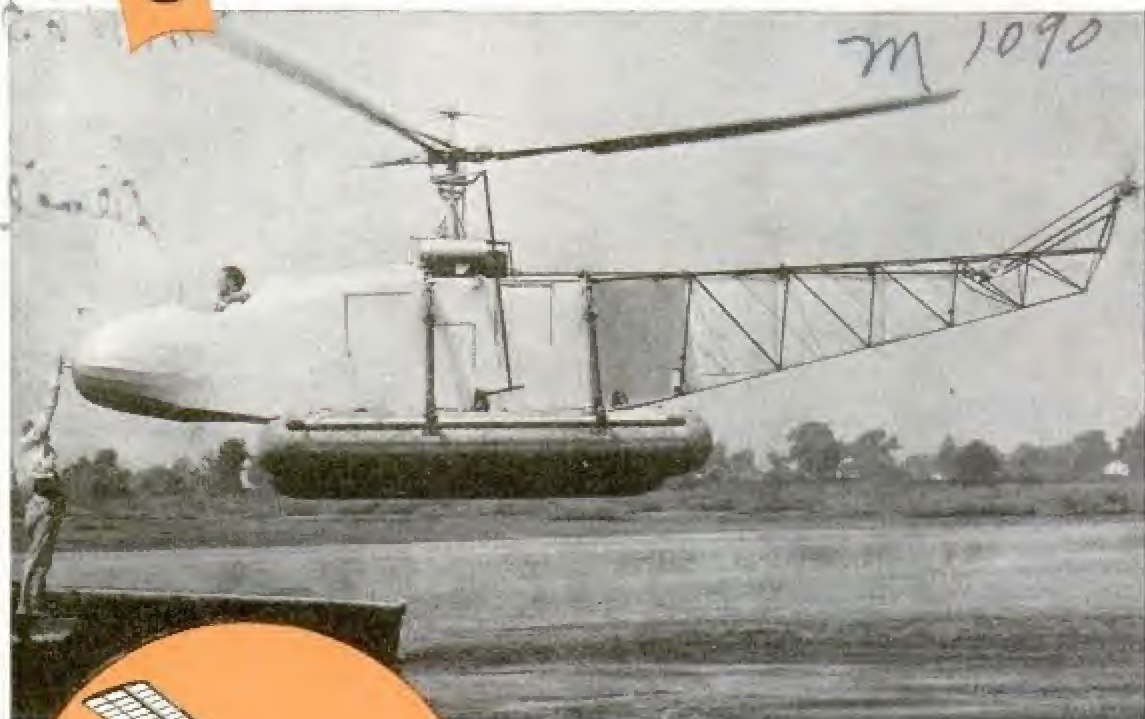
Ship's Variable-Pitch Propeller Controlled by Its Own Wake

7131

Blades of a ship's propeller would be set automatically at the angle that will assure most efficient operation by an invention of John Hays Hammond, Jr., patented recently. Pitch of the propeller's blades is controlled constantly by the slipstream of the vessel itself. Activating the unit is a hinged strut projecting from the hull. Pressure upon this, varying with the ship's speed, operates an electrical device that gives a slipstream reading on a dial. If this reading indicates inefficient operation, an electric motor automatically increases or decreases the angle of the blades.

Gloucester 27
Moore

SET 'ER DOWN *in* YOUR



Fitted with pontoons for landing on water or land, the Sikorsky VS-300 helicopter hovers motionless in air before alighting

Igor Sikorsky beside one of his first helicopters at Kiev, 1908. It was a beginning, but it wouldn't fly

Demonstrating perfect control, the pilot pierces a paper target and gently lifts away a metal loop set in top of a pole

By Roderick M. Grant

THIS is no midsummer day's dream. Your next car may be a helicopter.

Pure poppycock, you'll say; the thing is fantastic. For 30 years, if you're that old, you have read tales of that crazy contraption that would hoist itself by its own bootstraps six feet off the ground and then come down to the good earth with a bonebreaking thump. Then you'd drive twelve miles to the airport and watch those \$100,000 sky liners climb away gracefully at 125 miles an hour, and if you thought of the helicopter again you wondered why crackpots went on wasting time with these impractical dancing dervishes when the sky was filling with Clippers and Stratoliners and Flying Fortresses.

You have been misled. Alone, since 1908, one man has been laboring to build a craft that you can lift safely



Wrought-Sikorsky did!
United Aircraft, Stratford Conn

BACK YARD

from between the cherry trees and the Monday wash line in your urban back yard and set down as gently as a toy balloon between two parked cars.

And lo, the helicopter has arrived. You believe when you see it rise vertically to hover like the frozen motion of a hummingbird, swim backward in air as easily as forward, do a right-about-face with a doughboy's precision and swing from side to side as smoothly as a pendulum.

The thing still looks like the skeleton from an inventor's closet and you subconsciously search the sky for the invisible string from which it must be hanging. But it has arrived at its beginning, and the principal obstacles between the helicopter and your garage are lack of a nickname—helicopter is still a 25-cent word with controversial pronunciation—and lack of a production line.

The nickname is up to you. The production line is up to Igor Sikorsky, the unassuming genius who nursed the unbelievable craft for 31 years before he got it to work, and had time meanwhile to turn out some of the world's largest commercial transoceanic flying boats.

Mr. Sikorsky is a native Russian and today is a more passionate American than you or I. He built his first edition of the helicopter at Kiev in 1908. It looked like a Dutch windmill upended, and it wouldn't fly. That did not discourage Mr. Sikorsky. He built a second helicopter that also didn't fly. Then



In this panel are the three stages of the experimental helicopter, first of its breed to fly successfully. The original model, above, had outrigger structures extending from the tail, with twin rotors



The outriggers were dropped in the first major revision and a tower over the tail substituted (above), carrying a single rotor. In the present version the tower has been scrapped, pontoons replace wheels





Ingenious controls in main rotor mast permit sidewise, backward, forward or vertical maneuvers

chine again, and a flying generation had grown up before the Sikorsky helicopter first thrashed its great arms and rose into space.

That was 1939. In the four years since, 18 major changes have been made in the craft and more are in the making. The original helicopter of 1939 is the same steel dragonfly that darts over the bay at Stratford, Conn., today in absurd aerial evolutions. It is like the Model T Ford that entered its second

he began building fixed-wing craft, mostly multi-engine planes, until the tragedies of the bolshevik revolution drove him from his homeland. He translated his endeavors to America, building land planes and amphibions and flying boats. It was a long time before he tackled the wingless ma-

100,000 miles with none of its original parts.

Up to this moment Mr. Sikorsky has confined himself to a search for stability, control and smoothness of transmission and rotor operations. Those fundamentals having been solved, save for the refinements time and experience will bring, the inventor will be free after the war to attack the problems of production. They will be simple. Basically the helicopter is a framework of welded steel tubing with a main rotor and a tail rotor driven by a gasoline engine and operated by an ingenious set of controls; it should cost no more than a medium-priced automobile, and it presents much less difficulty than the automobile in mass production. Since the war's end will undoubtedly see a vastly expanded aviation plant seeking peacetime employment, the helicopter should find a home. There will remain the problems of stepping up performance beyond the present easy pace of 80 miles an hour, increasing the capacity of the experimental VS-300 to family size, and convincing you the helicopter is no neck-breaking aerial jungle gym for daredevils but the safest and most convenient aircraft invented for a cliff-dwelling kitchenette civilization.

So far as the neck-breaking proclivities of this flying machine go, it is significant that Mr. Sikorsky still has his own neck. True, in his pioneer experiments



Its arms thrashing just enough to counteract gravity, the helicopter waits upstairs while its "ground crew" attaches a can of gasoline to line to refuel

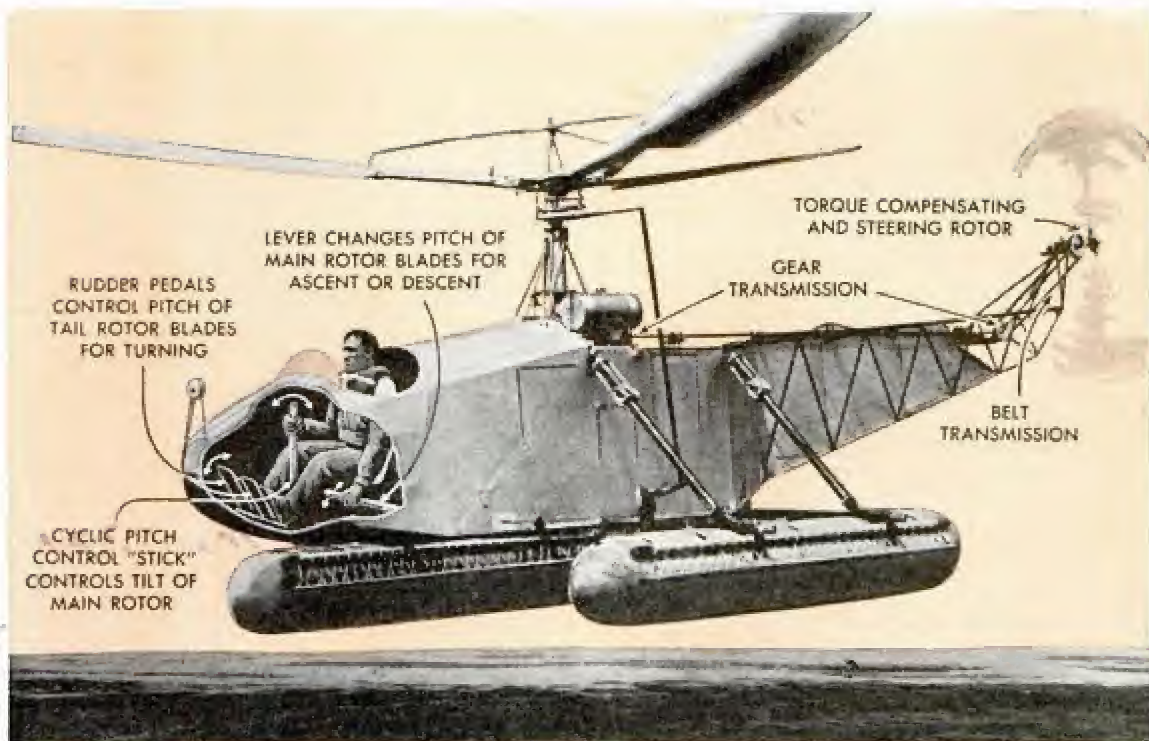


Photo-diagram shows the principal elements of control. After the war, you may learn to fly it in an afternoon

he took the precaution to fly his helicopter as a captive, maneuvering it over the factory yard while assistants restrained it within a safe distance of earth by rope. Now that the controls are perfected the VS-300 hops around as unfettered as a mosquito, which it resembles except for the sting.

"The helicopter can do what no eagle can," says Mr. Sikorsky. "Indeed, it can perform as no other thing on earth—fish, flesh, fowl or mechanical. No eagle can hover. No bird can fly backward. No ship can swim sideways. No plane can rise vertically from a standing start. But, to be quite humble about it, the helicopter can't do much that a mosquito can't do."

At the Sikorsky plant you may meet the only two Americans licensed to fly the only helicopter in the hemisphere. Igor Sikorsky holds No. 1 private license. Charles L. Morris, test pilot, holds No. 1 commercial license. It is the opinion of these two that you could learn to fly the helicopter in

two hours. You will learn more safely than the airplane pilot, for you need not roar across a field at 60 miles an hour to take off or alight. When the helicopter has its day, you can learn by maneuvering the craft through its three-dimensional repertoire while it hangs from its gyrating umbrella, anchored a few feet above the ground by ropes. If your engine fails, you drift to the ground under the restraining influence of the free-wheeling main rotor blades.

(Continued to page 161)

Mr. Sikorsky sets the VS-300 down between parked cars, in a space just wide enough to allow clearance of the fourteen-foot main rotor blades



Machine "Irons Out" Nails At Rate of 31,000 a Day



Straightener removes kinks to reclaim bent nails

Crooked nails, made valuable by the diversion of new production to war industries, can be given a new lease on life by straightening them in a machine that "irons out" 31,000 nails in a single day. Invented by George D. Hulburt at 20th Century-Fox film studio, the reclaiming apparatus removes the kinks by stamping the nails into a straight groove.

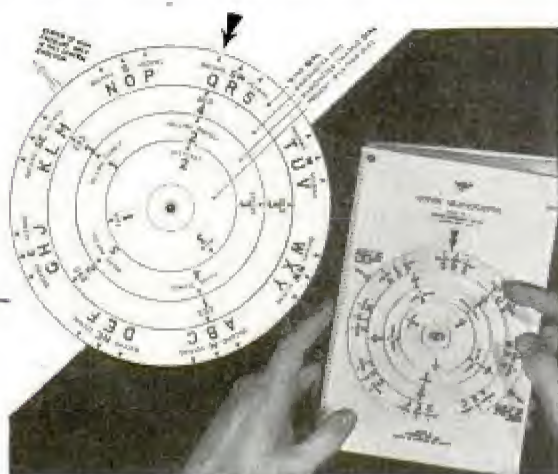
630,770 of Nation's Specialists On Call for Wartime Duties

Signed up for work wherever they may be needed in this technician's war are 630,770 scientists and professional men and women, who can be located instantly for vital and unusual war jobs. So great is the demand for persons of their skills that names of 140,000 of those registered have been sent to war agencies requesting them. A checklist of American brainpower, the list is termed the National Roster of Scientific and Specialized Personnel, and it was established before Pearl Harbor by the National Resources Planning Board and the U. S. Civil Service Commission. Its aims are to assure that the job is tailored to the person qualified to hold it, to provide a constant check on who is available and what jobs need filling, and to guarantee that immediate needs for skilled persons do

not halt research that has its sights trained on something more important for the future. Registration is voluntary. Included on the roster are 80,605 chemists; 11,054 physicists and astronomers, 5,933 psychologists; 34,053 civil engineers; 4,825 aeronautical engineers; 3,265 automotive engineers; 21,669 mechanical engineers; 7,967 chemical engineers; 22,027 electrical engineers; 5,630 radio engineers; 7,170 biologists; 9,028 geologists; 9,154 mathematicians, 7,990 economists and 1,221 naval architects.

Home Forecaster Dials Weather From Known Conditions

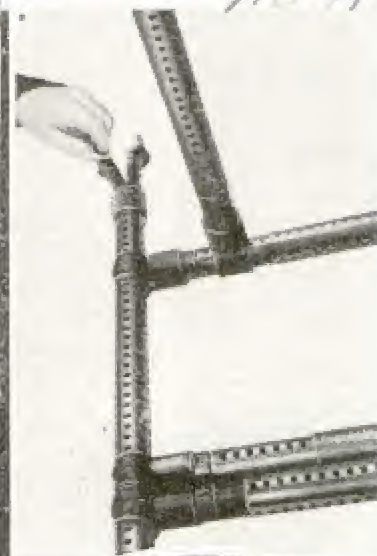
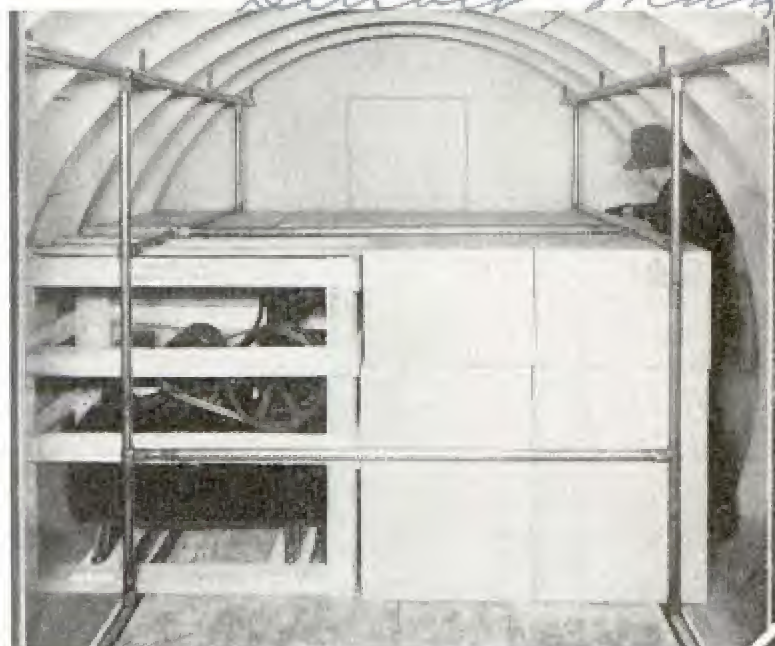
You can be your own weatherman with a dial forecaster that requires the operator to make four simple observations of the weather existing at the time and to set four rotating disks accordingly. The observations, each represented by a separate dial, include the present wind direction, barometric pressure, which way the barometer is changing, and a choice between "fair," "overcast" and "rain." The wind-direction dial includes an indication as to whether the wind is backing or veering, that is, whether the last change swung counter-clockwise or clockwise. When the four disks have been arranged so the indicated weather conditions point toward the red arrow at the top of the dial, they line up three digits and a letter of the alphabet. The user then locates this reference in a table, which gives a definite weather prediction covering an area within a radius of 30 to 50 miles and a period from 12 to 24 hours. Accompanying the forecaster is a complete set of instructions.



After disks are set (left) answer is found in table

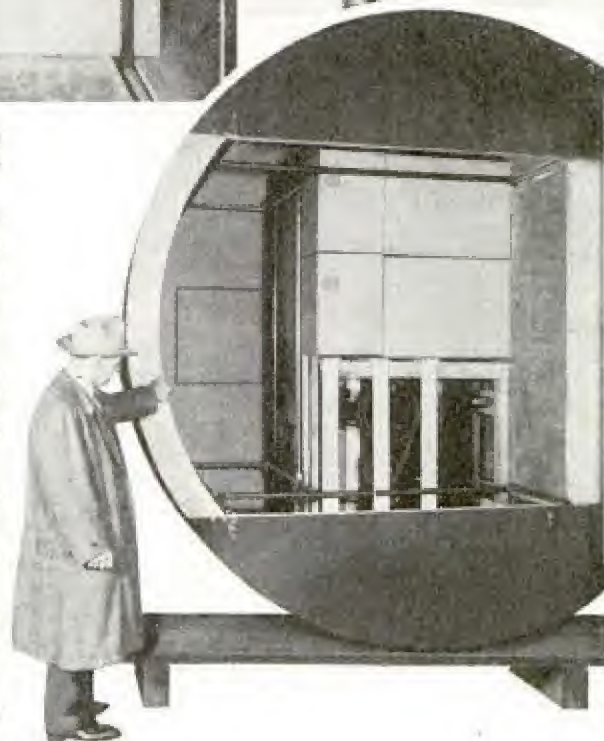
POPULAR MECHANICS

*J.C. Kaldrick, 71 P Evans Road
Co. Fallerton at Greenfield*
Hold-Down Tubes Fasten Cargo in Airplane
Detrust, much. 7/11/40



Flying level or banking (simulated above and right) adjustable bars (upper right) retain grip on cargo

To keep cargoes from shifting about in freight-carrying airplanes, hold-down equipment has been developed that serves the additional advantage of speeding the loading and unloading. A series of tubular bars, four of them installed permanently in the ship, combine to bear against the stowed material so motion of the ship can't budge it. Two of the tubes are installed lengthwise in the ceiling, two others parallel them in the floor. Removable telescoping bars may be attached to these in vertical or horizontal position by means of split jaws at the ends that are provided with dowel pins which "bite" into holes in the cross bars. The removable members can be placed to exert pressure downward, sidewise or endwise.



Tune-Up for Lower-Octane Gas Calls for Only Minor Adjustment

No major changes in the motors of busses, trucks and other commercial vehicles because of the reduced anti-knock value of gasoline will be necessary, driving tests have shown. Fuel consumption and power output are little affected if the spark timing is properly retarded. Only if the octane rating falls below 65 is performance likely to be noticeably altered, since truck drivers in road tests reported they could detect no difference in performance between gas-

olines of 65 and 72 octane. Carburetor adjustment does not appear from these tests to be worth while. With the lower-octane fuel, engineers warn, closer maintenance will probably be necessary, and the proper spark adjustment should be made for each motor, since motors vary even though of the same model. Most passenger car owners have found they can adapt their driving to the fuel and avoid knocking just by easing up on the accelerator.

Ref. card: Dr. Wm. J. Kerr, U. of Calif. Medical School, San Francisco, Cal.

The MYSTERY of the COMMON COLD



Measuring and comparing flow of blood in finger and nose (above) with a plethysmograph in the environment room. Below, influenza virus is transmitted to a mouse in Navy research laboratory



EVERYONE "knows" common colds are contagious. The chances are that you can trace your last cold directly to someone else who had a sneeze.

But can you?

Science can't. Science hasn't been able to find a germ or virus that causes colds, not even with the electron microscope that discovered the virus of influenza, a protein only 10 millimicrons in size, smaller than some molecules.

Dr. Wm. J. Kerr and his associates at the University of California Medical School wanted to learn exactly how infectious the common cold is, so they placed healthy volunteers who catch cold easily in an environment room where temperature and humidity are controlled, then exposed them to other people who were suffering from colds. All slept in the same room, drank from the same drinking glasses, lived together for days. Not one of the 30 without colds caught the symptoms from those

Ref: Influenza! Commander Albert P. Krueger Univ. of Calif. Berkeley Calif.

Radio fever machine invented by Dr. Lee De Forest treats colds and respiratory infections

who were sneezing and coughing.

Such experiments are leading many authorities to the belief that many colds are merely mechanical upsets. Some of us are not always able to react properly to overheating, exposure to drafts, or changes in the weather. Abrupt weather changes appear to afflict many people with the symptoms of colds at about the same time, leading to the impression that one person can infect others. This apparently is the basis of the old story about the island of St. Kilda, whose inhabitants were said to suffer colds only when people from the outside arrived by boat. The truth seems to be that sailboats could reach the island only during a northeast wind, and it was the cold wind, not the visitors, which caused outbreaks of sneezing.



The latest explanation of colds has to do with the spongy tissue that covers the turbinates in the upper nose. Ordinarily the air we breathe is heated and moistened on its way to the lungs by this tissue. Now and then, depending on the severity of the exposure and the general resistance of the

Left, multiple temperature indicator used to check temperatures of different parts of body in research on common colds. Right, attaching the leads for measuring temperatures at various points on a subject's arm





Combination stethoscope, called a symballophone, aids in locating and studying respiratory infections

person, this air-conditioning apparatus gets out of kilter. The unpleasant conditions we know as a cold result. There seems to be a connection between the temperature of the skin and the actions of the turbinates, and this may be the reason why exposure to drafts that cool the skin often give us colds.

Today Dr. Kerr and a team of physiologists and doctors are studying all such physical manifestations. They are using an environment room in which temperature and humidity can be controlled precisely. Any type of climate can be reproduced inside its four walls, and even the barometric pressure is regulated. The entrance is through an air lock. You close one door behind you before opening the door that leads into the environment room.

In this room the research team is studying the mechanism of the skin,

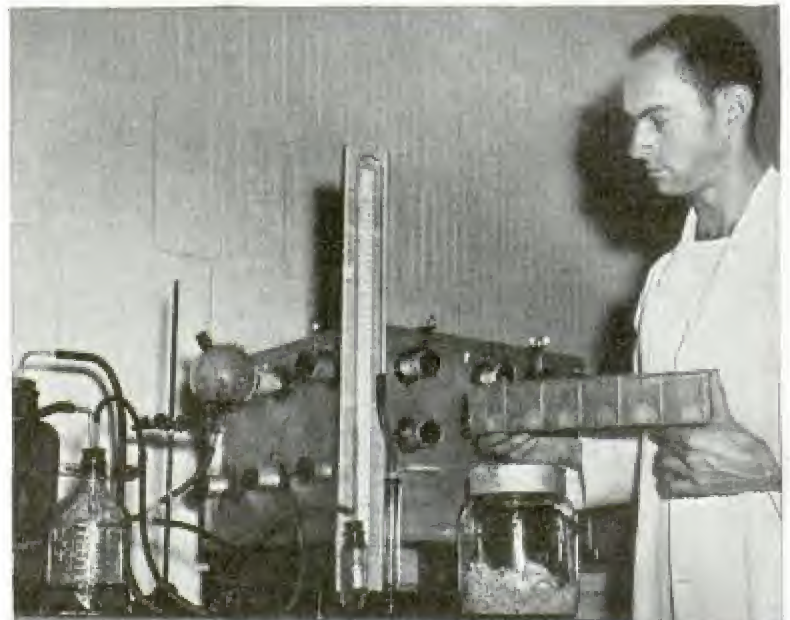
Moisture containing influenza virus is atomized and injected into test chamber containing mice

its temperature and blood circulation. Volunteers susceptible to colds are subjected to drafts and other adverse conditions, then their automatic reactions are studied. The research program will consider all respiratory diseases and will even investigate the possible effects of vitamins and diets on susceptible people.

No one ever died of a common cold, probably, yet colds can't be classed as mere annoyances. For one thing, they pave the way for many kinds of secondary infections that are often serious. The irritation is apt to result in such inflammations as sinusitis, tonsillitis, or bronchitis, and the micro-organisms that cause pneumonia and other respiratory diseases get a chance to go to work. These complications begin in the later stages of the cold and blend so well with it that most people simply think their cold is getting worse.

A survey made one spring week indicated that some 23,000,000 individuals in the United States were suffering the symptoms of colds at the same time. Another estimate is that the average worker loses eight days a year from illness, a considerable part of which loss is caused by colds. If such illness could be reduced by only one day per worker per year, the equivalent of the full time work of an additional 60,000 men would be gained.

To reduce colds among war workers, Douglas Aircraft Company last winter spent \$25,000 on an anti-cold program that included distribution of pills intended to increase resistance to the condition. Simi-

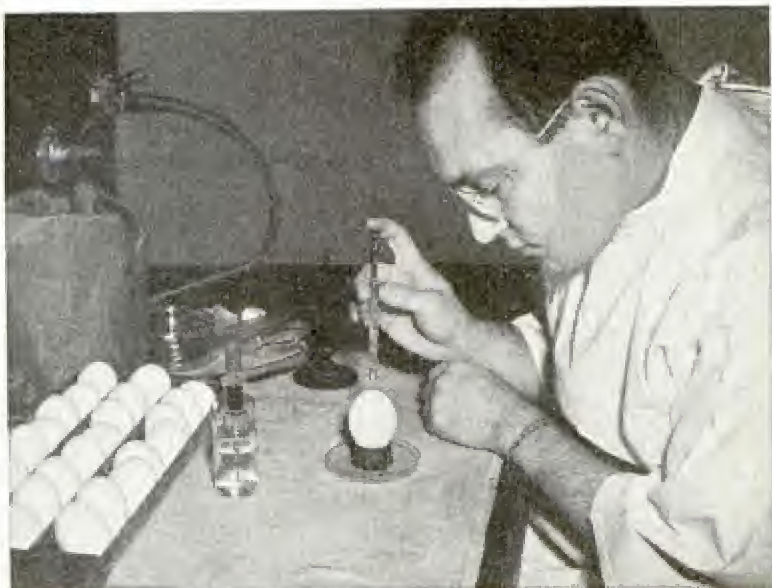


larly, 1,000 employees of Lockheed Aircraft Corporation are participating in a 6-month nutrition experiment in which their normal diets are supplemented with vitamin tablets. These are intended to improve their general health, reduce fatigue, and thus indirectly reduce susceptibility to colds.

Unlike the common cold, influenza has been proved to be a virus disease. It is marked by a sharp temperature rise, pains in the joints and muscles, is more debilitating than a cold, and requires longer convalescence. The virus is carried by droplets in the air. A minor epidemic of influenza occurs in the United States every other year. A small outbreak is expected in 1943. No one knows why major epidemics of flu occasionally sweep the world, the last of which, in 1918, resulted in millions of deaths.

But, if such a pandemic should occur again, the United States is in far better position than in the past to control the

Cold quartz ultraviolet light sterilizes air, killing germs and "flu" virus



Top, injecting influenza virus into eggs to prepare vaccine; below, air lock leading to environment room at University of California has double-pane windows



spread of the disease and to reduce its mortality. Various groups are engaged in intensive studies of influenza. Type A, Type B, and a probable Type Y have been distinguished. One of the research groups, the Navy's Laboratory Research Unit No. 1, on the Berkeley campus of the University of California, has been administering a virus-vaccine with promising results in some 50 percent of the vaccinated personnel. Indications are that more effective vaccines will be developed that will provide immunity to the disease to an even greater percentage of those who are vaccinated. Influenza can become a deadly enemy in wartime, hence the Navy's interest in conquering the disease. The laboratory re-

(Continued to page 154)

Utility Trailer 3200 Chicago Ave. m 1116

Pyramid Trailer Transport Seats 206 Troops



Three-tiered for easier loading and unloading, as in the case of enemy strafing, trailer rolls on 14 wheels

Accommodating 206 men at a time, a 30-foot trailer designed for troop transport is in use at March Field, Riverside, Calif. The men sit in the open on three tiers arranged like steps on both sides, permitting speed in loading and unloading. In areas where

air attacks may be imminent, men on the trailer can dismount and disperse quickly. Rolling on 14 wheels, the trailer is towed by a truck. When large bodies of men are transported over long distances, these trailers greatly reduce the length of the convoy.

Office Tongs Lift Staples Easily Without Ripping Papers



Pliers-like grip on handle makes staple come clean

Operated like pliers, a tiny staple remover lifts out the metal fasteners without tearing the papers. Made inexpensively of plastic, the tool may be carried in a pocket. It has a flat nose that is inserted under the staple, and pressing the handles together spreads the staple so it comes out easily.

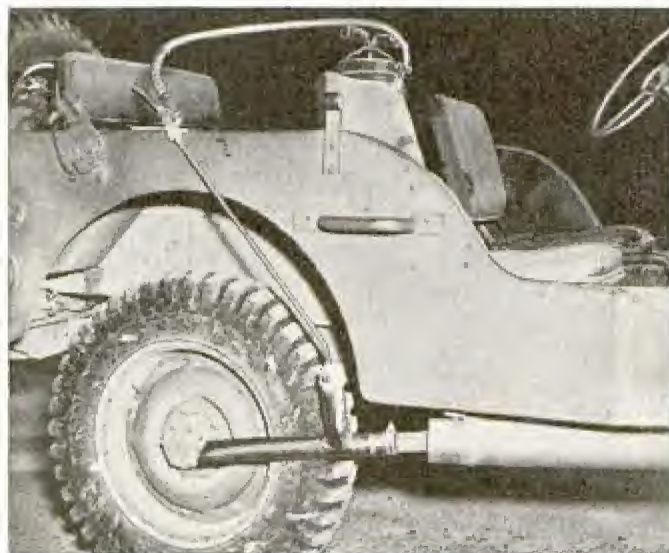
Helvetium, Last Known Element, Photographed for First Time

Chemical element No. 85, last discovered of all the 92 substances that make up all matter, has been isolated from radium, its parent, in sufficient quantity to be photo-

Rep
graphed by scientists at the Radium Institute in Bern, Switzerland. Known both as helvetium and as alabamine, the element was not isolated until 1940 and then the discoverer, Dr. Walter Minder, extracted only one ten-thousandth of a milligram from a gram of radium. Besides being the last element whose existence is believed possible, helvetium is also the 10th and last radioactive element in the series whose existence was established when the Curies discovered radium in 1898.

Jeep Spouting Cloud of Gas Trains Men for Attack

m 11/5
Officers and men at Geiger Field, Wash., are subjected to occasional "friendly" attacks of tear gas spouted from an army jeep traveling around the field constantly. This keeps the personnel ever on the alert, teaching them to be quick in donning gas masks in the face of surprises, the idea being that when eventually they go into action they will be ready for real doses laid down by the enemy. The tiny car releases clouds of gas at unexpected times and places. It carries the fluid in a storage tank connected to the exhaust tail pipe. Pressing a lever sprays fluid into the pipe, where it changes to gas and shoots out with the exhaust.



Pressing lever by seat sprays fluid into the hot exhaust pipe

Wire 'Umbrella' Sheds Lightning Aimed at Explosives Plant



Steel wire catches bolt and carries it to rods in the ground

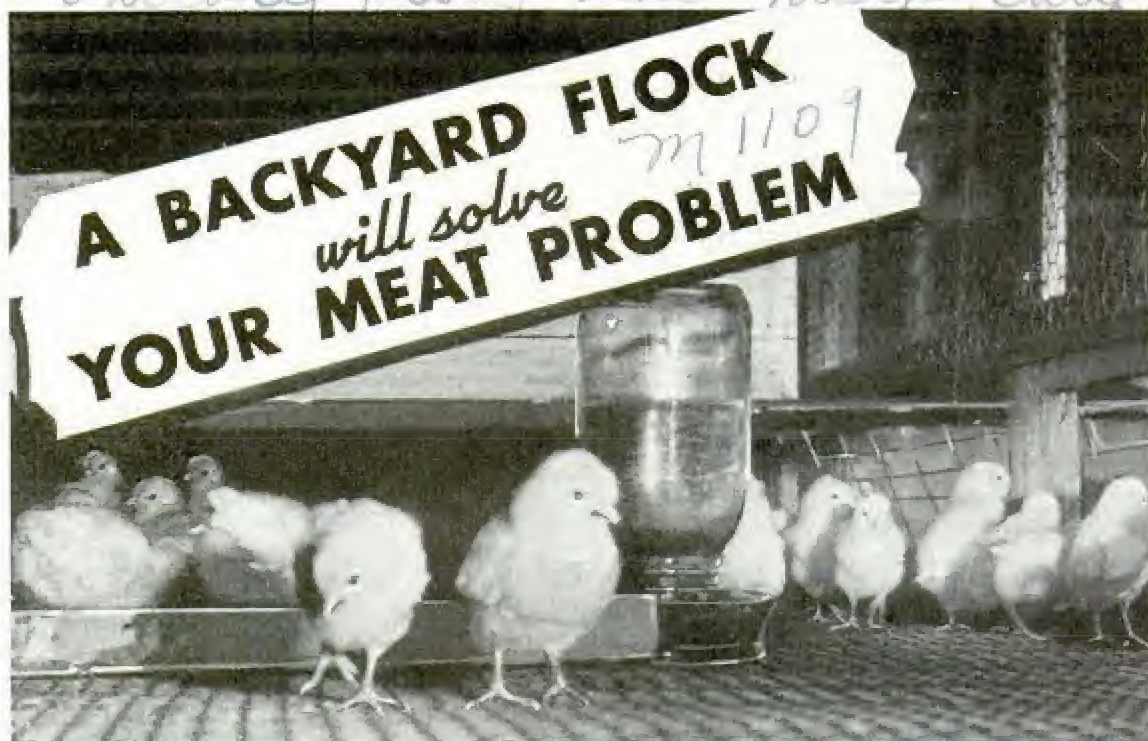
Lightning streaking toward munitions plants or oil storage centers at more than 11,000,000 miles a minute will hold no terror for workers if the structures are protected by a wire "umbrella" developed by Westinghouse Electric and Manufacturing Company. It is simply a steel wire strung above the building and anchored to a tall wood pole at each end, and from there connected to steel rods buried

in the ground. Lightning rods previously used required about 250 pounds of copper, whereas the same building can now be shielded with only 60 pounds of steel and the two wood poles. The new design eliminates the danger of lightning leaping to metal sections of the building and causing sparks, since the whole charge is caught by the wire and led harmlessly into the earth. The system was tested on models at Westinghouse high voltage laboratory.

Blankets made of layers of reinforced crepe paper, said to have warmth-retaining qualities comparable to some textiles, are appearing in department stores.

Edward Johnston 12112
Victory Blvd Van Nuys Calif

Stinson



Chickens grown in backyard pen live out their lives on wire; their feet never touch the ground

A PEN 4 by 12 feet in size, small enough to tuck away in a corner of your back yard, is all the space you need for raising enough poultry to keep your family in meat and eggs.

Instead of allowing your flock to run loose you should copy the modern commercial "egg factory" method of raising them on wire. An elevated pen with a wire mesh floor keeps your flock healthy and sanitary.

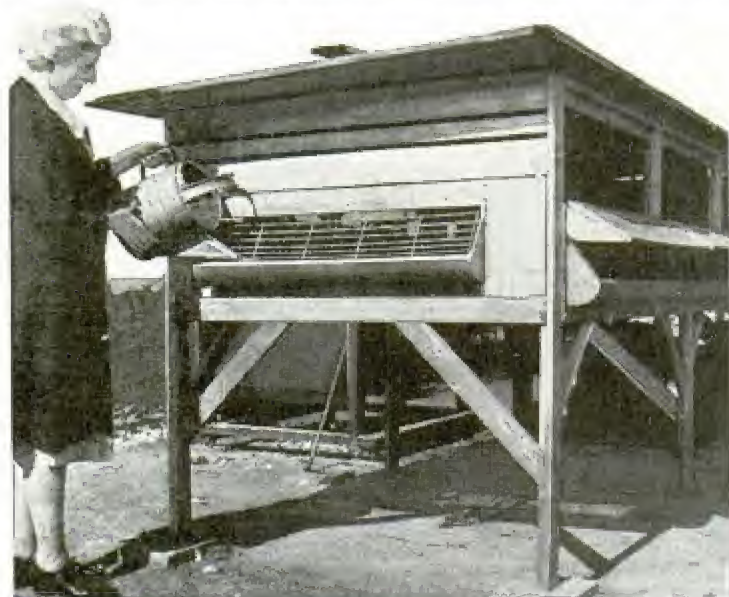
It's cheapest to buy day-old chicks of good tested stock, from an accredited hatchery.

Most hatcheries have chicks available all year and will ship them to you in sturdy cardboard boxes. More expensive, but far less trouble, is to buy chickens that are from one to two months old. These are usually available in the spring and early summer, though possibly you will need to arrange with the hatchery ahead of time to rear them to this age. By doing so you avoid the need for a brooder.

Select a breed according to your needs. White Leghorns are good layers and five of them will feed on what four birds of a larger variety would consume. Barred Rocks and Rhode Island Reds are larger, plumper birds with more meat. They eat more than Leghorns, and are good layers. It's best to buy about two and a half times as many chicks as you will want for an egg flock. A few will die, and half of the rest will be cockerels. These make good fryers at three and four months, just as they begin to crow.

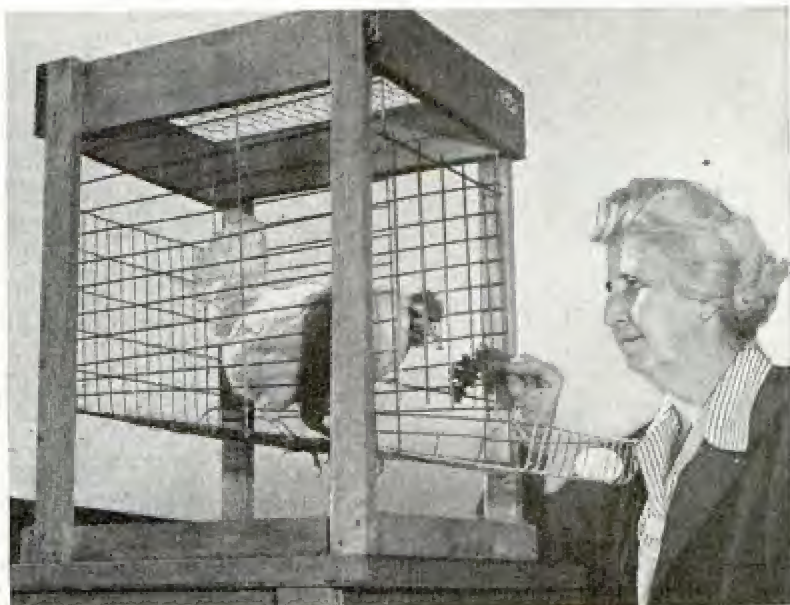
Of 50 day-old chicks, 18 or 20 will become laying hens.

Fowl raised on wire are healthier than those kept on the ground. Metal water trough on this pen is easily refilled

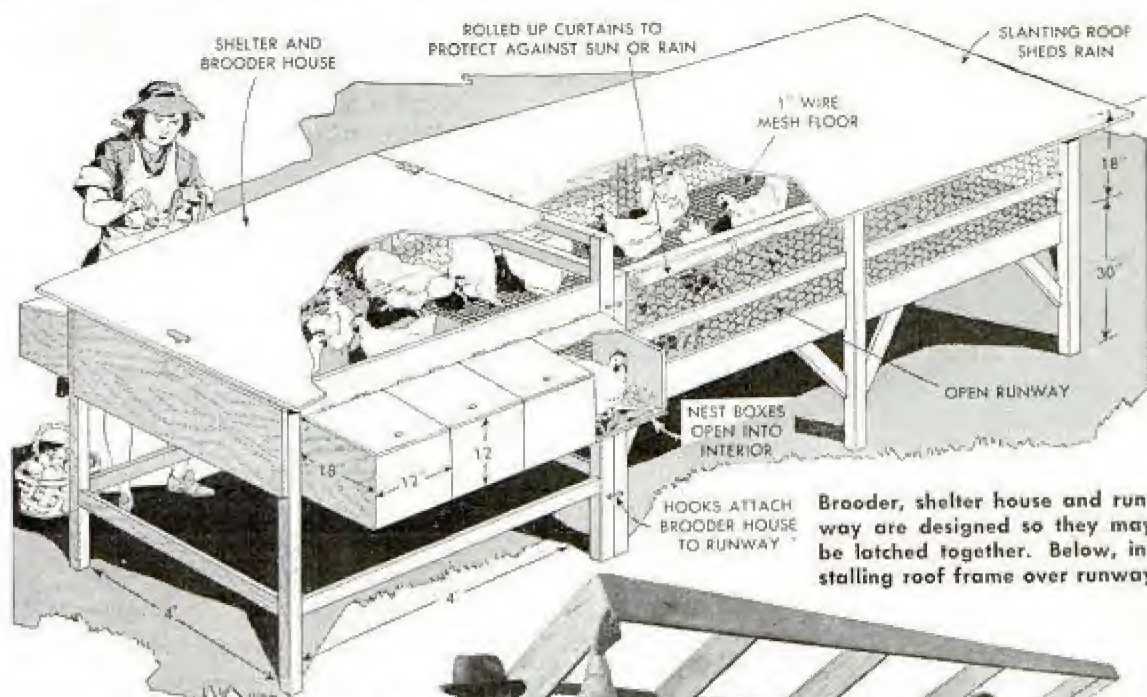


Eight or ten of these will lay more than enough eggs for a family of four, leaving up to a dozen for a chicken dinner. Keep the hens that lay the most eggs. If you buy partly grown chicks that are out of the brooder stage you can start with 35 or 40.

The recommended way to keep poultry is in batteries of individual wire cages. There isn't enough wire to go around, these days, and your next best bet is a wire runway, even if you have to straighten and patch secondhand wire.



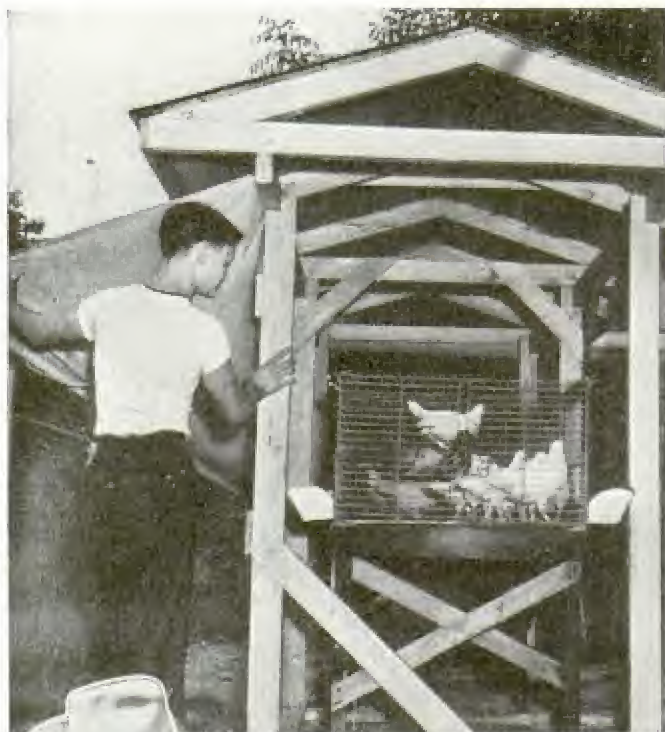
Slanting wire floor of this single cage allows egg to roll into tray



Brooder, shelter house and runway are designed so they may be latched together. Below, installing roof frame over runway

A good size runway for a flock of up to 24 mature birds is 4 by 8 feet in area, 2 feet high, and with a 4-by-4-foot shelter house at one end. The house and runway are supported on legs 30 inches off the ground. The floors of both the house and runway are of 1-inch wire mesh, and both are roofed with





Canvas awnings at the sides of this runway protect chickens from rain and heat of sun



provide three or four nest boxes, 12 by 18 inches in area and 12 inches high. The slanting tops are hinged so that you can reach in to collect the eggs. Paint all woodwork with aluminum paint if it is still available. Next best is creosote paint and next, whitewash.

Housing chickens this way is a compromise between the old method of allowing them to run on the ground and the modern commercial battery method. Poultry raised on wire are healthier than if kept on the ground, and the confinement does the birds no harm. They remain clean because their droppings fall through the wire floor to the ground, which should be kept dry and unpaved. The droppings dry rapidly in the open air, create no odor problem, and make excellent garden fertilizer. A fly trap should be installed near the pen, preferably between the pen and your house. An electric flytrap, protected from the rain, is recommended.

Decide on one of the commercial feed mashes and stick with it, following directions. Keep the feed troughs at least half full. Stirring

Home-made brooder holding a dozen chicks is heated by light bulb (left). Day-old chicks (below) are shipped in boxes with air holes

boards covered with roofing paper. The runway walls are of chicken wire. Removable feed troughs may be hinged to the walls of the runway, or the troughs may be placed inside, on the wire mesh floor. There must be room at the troughs for all the birds to eat at the same time, without crowding. A water trough may be placed across the far end of the runway. The runway should face the south, with the house at the north end. The slanting roof of the house is hinged for ready access.

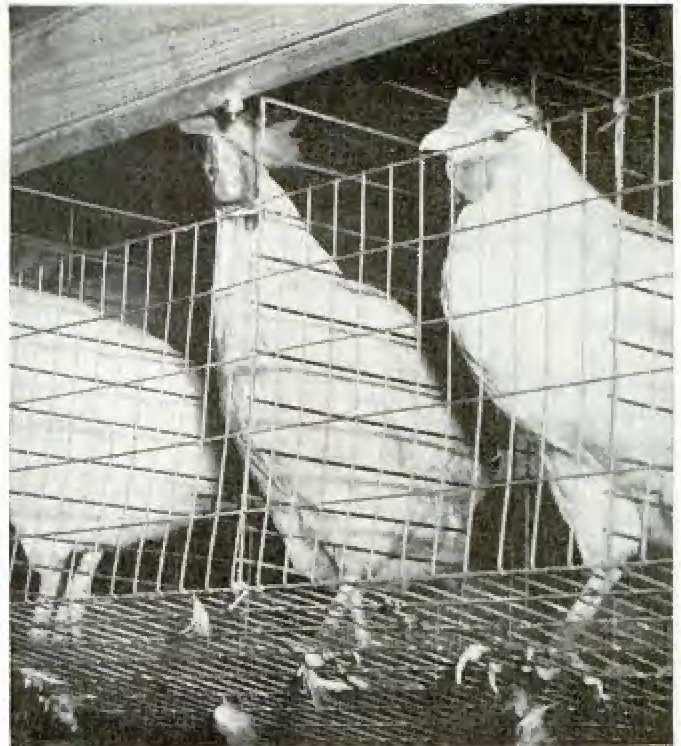
The poultry will roost on the wire floor in the house. Each side of the house should be built out to



the feed up occasionally in the troughs arouses the interest of the hens and causes them to eat more.

Chickens require plenty of fresh water, grit, and feed. They need sunshine but also need protection from the hot sun in the summer. Lath latticework may be placed on the sunny side of the runway; or canvas curtains will protect the birds against either sun or rain. Hens do best at a temperature of about 60 degrees. In the south and southwest the flock can be left outdoors all year, but in the north and east in winter the chicken house and runway should be moved under a shed or into the garage. Ordinary cold weather doesn't hurt chickens but drafts do. In cold, dark weather, hens lay less, so moving them into a heated garage, with lights burning in the daytime, will reduce the mid-winter egg-laying slump.

Chickens are inclined to peck one another unless confined individually. One tablespoonful of salt per gallon of drinking water is one remedy, but should be used as a cure and not as a preventive, since chickens can't stand much salt. There are also medicated salves that may be placed on the birds to stop the vice. Likewise, it is not advisable to run immature chickens and grown fowl in the same pen. If you wish to have fryers available all year it is best to build another runway. With combinations of equipment some people start 25 chickens four times a year, then have fryers and roasters always available.



Overhead "dewdrop" on water pipe serves as drinking fountain

Raising young chickens in a brooder is more trouble than buying partly grown fowl, but it is a lot cheaper. Build the runway and shelter house described above as two units that can be locked together. Thus the shelter house can be removed and a brooder substituted at the end of the runway during the first month or five weeks.

The brooder is a box 3 by 4 feet in area, up to 18 inches high, mounted on 30-inch legs, with latches to lock it to the open end of the runway. The floor is of $\frac{1}{2}$ -inch wire mesh, with a wooden floor several inches

(Continued to page 160)



Garbage can with sliding door dispenses food. Pen at right takes up only a corner of the back yard



allen Warren Elliott
7 Park Ave, N.Y.

Mobile School Teaches Seamen to Fight Planes



7/10/36
In teaching merchant marine seamen to combat aerial attacks, the navy found it more practicable to take the classroom to the docks than to bring crews ashore for instruction. So buses like the one below were converted into mobile schools by fitting them with five kinds of machine guns. Left, within bus, an instructor demonstrates the loading of .50-caliber Browning machine gun



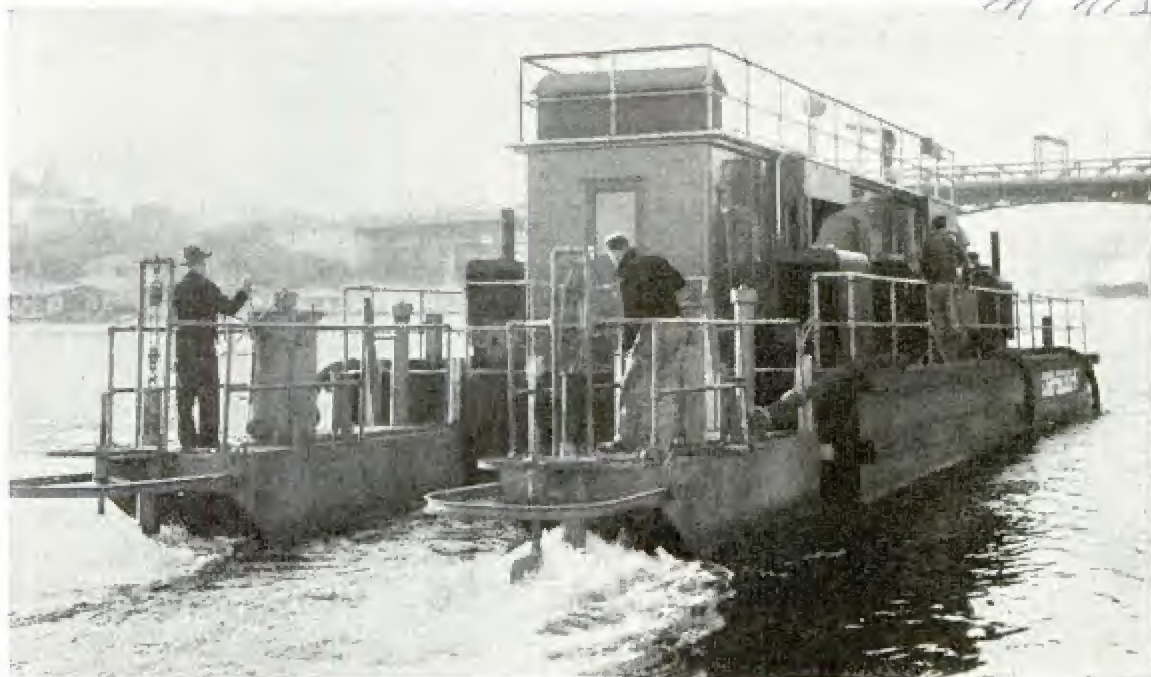
Members of an armed guard, left, are learning to sight a 20-mm. machine gun. However, man behind gun is a bit too close, as recoil would drive sight into his eye. Knowing the guns, merchant crews gain more confidence in protection against planes and are enabled to take a hand in repelling air raids instead of standing by

In the armed guard mobile training unit, right, merchant seamen are being taught how breech block and barrel of .50-caliber Browning gun are removed. Other machine guns carried are .30-caliber Lewis, .30-caliber Colt and .30-caliber Browning. Going from dock to dock, these mobile schools have trained thousands of men in the handling of guns. Members of the deck crews and even men from the engine room gang take instruction. Bus crews usually consist of an ordnance officer, chief gunner's mate, gunner's mate and the driver, and 10 students comprise an average size class

U. S. Navy photos



Floating "Marine Tractors" Push Fire Barge



Driven by the floating outboards, fire barge carries eight 95-horsepower pumping units for fighting flames

Two "marine tractors," each floating on a pontoon of its own, provide propelling power for a fire fighting barge built for the Coast Guard to be used against dock and other marine fires. These new-type outboard engine units, produced by Chrysler Corporation, can be attached readily at the stern of any flat-bottomed cargo-carrier, doing the work of a tugboat and giving a

cheap source of power with speeds ample for ordinary commercial purposes. Each floating engine has its own deck and steering wheel, and each must be manned by a separate quartermaster while under way. Its use, however, is limited to smooth bodies of water such as rivers and inland seas where the men would not risk being swept overboard by heavy seas.

Sky-Scraping Dump Trailer Turns at a 90-Degree Angle

Rearing up on its tail wheels, a double-jointed truck-trailer unit used by General Electric Company for rubbish removal tilts to a maximum elevation of 19 feet 6 inches above the ground. At the same time the trailer, which is 17 feet 4 inches long, can dump at right angles to the truck. The unit saves 67 percent of the labor while accomplishing 25 percent more work than three 3-ton dump trucks it replaced.

❏ You can obtain additional information about products described in this magazine by writing to the firms listed in the Where-to-Buy-It index. Say You Saw It in Popular Mechanics.



Double-jointed truck-trailer is raised 19 feet to dump load

771123
SAILORS of the AIR

When the huge balloons that protect vital areas from low-flying bombers are brought down they're deflated and the gas is stored (right) in metal cylinders for re-use. It takes an expert crew of soldiers who "know the ropes" like sailors to handle barrage balloons



U. S. Army Signal Corps photos



↑ Gathered around "inflated octopus," soldiers at army balloon training center listen to instructor while crew in the background demonstrates correct method of launching gas bag

Below, rigging model of ballonet. This balloon has special chamber with wind scoop intake to keep pressure constant



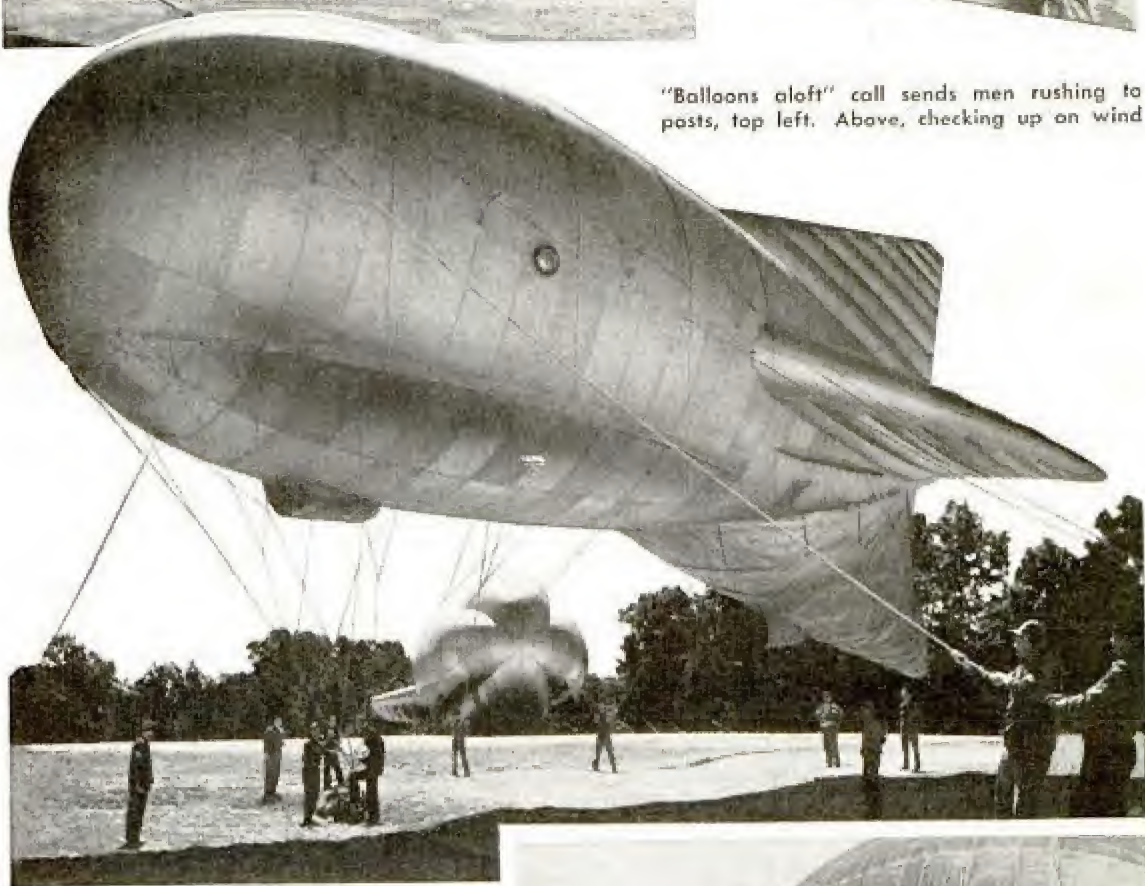
Down she comes, as a motor-driven winch winds in the steel cable holding balloon

Ref: Allen Thorne & Co. Ltd.
 7 Park Ave, N.Y.C.

Fly BARRAGE BALLOONS



"Balloons aloft" call sends men rushing to posts, top left. Above, checking up on wind



† Bedding down a balloon with ground mat to protect fabric before bag is deflated and stored. Outer covering is made of cotton impregnated with synthetic rubber which holds hydrogen gas better than natural rubber. For army training, a balloon 35 feet in diameter and 87 feet long is used on one steel cable

Right, barrage balloon "sailors" call this operation "feeding the baby"—inflating with gas from bottles, or cylinders. These balloons are capable of rising to high altitudes



1.000.000 Newspictures Inc
401-800, 7th St.

Steam Roller Left Behind by Japs In Fight for Solomons



U. S. Marine guarding steam roller left by fleeing Japanese

In their hasty withdrawal from positions on Guadalcanal Island in the Solomons, the Japanese abandoned a steam roller which they had used for smoothing airfield runways. The slow-moving roller did not have the speed necessary to escape the offensive action of U. S. Marines who took over the island.

Railroads Abandon 2,500 Miles While Hauling Record Load

Freight carried by American railroads reached a record volume of 630,000,000,000 ton miles in 1942—the equivalent of 630 billion tons carried one mile—and paradoxically, in this record year more miles of track were abandoned than ever before. The cargo handled was 155 billion ton miles greater than in 1941, and was more than one and one-half times the volume moved in 1918. A new high in passenger traffic was also established at 53,000,000,000 passenger miles—up 80 percent from 1941 and 13 percent above the passenger peak set up in 1920. There were 74 miles of new line built during the year—the largest amount of construction since 1937. The United States railway system was expanding through almost exactly a century begin-

ning in 1830, new mileage reaching its zenith in 1887 when 13,081 miles of track were laid. Since 1931 the average annual construction of new lines has been about 70 miles. In Canada, except for the year 1938 when 101 miles of track were laid, only nine miles have been constructed since 1932. Abandonment of track went above 2,000 miles for the first time in 1942, when 2,516 miles of track were officially abandoned, including a 142-mile stretch in Utah where the golden spike ceremony linked the Union Pacific and Central Pacific in 1869 into the first transcontinental railroad. Since 1931 a total of 18,832 miles of railroad have been abandoned.

Webbed Swimming Glove Adds Power to Stroke

Greater forward pull for swimmers is possible with a webbed glove invented and patented by James F. Myers of Oakdale, Pa. Consisting of fingers and thumb with webs between them, the mitt is joined by reenforcing material at the base. A strap at the back is anchored around the wrist.



Webbing between fingers gives swimmer more power

48 Railway Age
Jan. 1943

Ill. Tribune - 1/31-43

Equipment for Giant Dam Flown to Wilderness

Borrowing a page from the annals of U. S. Army transport, Canadian engineers are using airplanes to carry thousands of tons of equipment—even horses—to the wilderness site of the Shipshaw power development on the Saguenay River in Quebec. Big bulldozers, trucks, steam shovels and other bulky items are dismantled and loaded into planes, rushed to the site and put together in a jiffy. More than 850 workmen also have been transported by cargo planes. When the giant dam is completed it will be second in size only to the Grand Coulee on the Columbia River. The \$65,000,000 project will generate 1,200,000 horsepower which would be sufficient to light every home on the North American continent. The power, however, will be used to make aluminum for planes and other war uses. Construction of the dam, now more than half completed, has been pushed at top speed through two winters when temperatures dipped to 30 and 40 de-

grees below zero. Some 5,731,000 cubic yards of earth and rock were excavated, compared with 5,500,000 cubic yards for the building of Boulder dam. The last rock plug blown contained 18,000 cubic yards. Thirty thousand cubic feet of linear diamond drill holes were pierced to move this barrier of solid rock. When the explosive charge was set off, boulders weighing 400 pounds were hurtled 1,000 feet in the air. In the wilds above the main dam, smaller "storage dams" are being built to guarantee a minimum output of 970,000 horsepower. The storage dams conserve the waters of streams entering 400-square-mile Lake St. John from which the Saguenay flows. The main dam has a drop greater than that at Niagara Falls. Twelve steel headgates will control the rush of water as it is carried into the turbines through six tunnels 30 feet in diameter. Building the giant project has already taken a toll of 62 lives.

Radio "Ears" for Deaf Are Like Two-Way Police Sets

Miniature radio sets that enable the deaf to hear and send messages are being tested by the Illinois State Welfare Department. The "radio ears," which are compared to the two-way radio communication systems used by police, involve the use of low-watt, ultra-short-wave individual "transceivers." Sending and receiving messages are permitted within the wave band and limited power radius of each set. With this device, a deaf person "hears" by vibrations which are set up on both the ear drum and bone. If tests prove successful, the "trans-

ceivers" will be used in schools for the deaf. This is expected to speed up the education of afflicted children once they learn to associate the sounds they hear with objects already familiar through visual experience. This correlation process is expected to require about a year. Aside from opening up a new auditory world to the hard of hearing, the invention is expected to reduce the cost of educating deaf children which is now about twice that of educating normal children, according to Rodney H. Brandon, Illinois welfare director.

Fluid Coal That Flows in Pipe May Substitute for Fuel Oil

"Fluid" coal, so finely pulverized that when mixed with air it can be pumped through pipes a quarter-mile long, is being studied as an alternative for fuel oil in industrial heating processes, to relieve the oil shortage. It is produced by grinding coal to dustlike fineness in specially designed mills. A stream of air entering the mill picks up the particles and delivers them to collectors. When not impacted, the material flows through the fingers, and when mixed with air it will flow through pipes and spray out of jets. Pulverized coal

was widely used before the discovery of vast new sources of oil and gas brought sharp reductions in the costs of these fuels. In 1920, there were 690 furnaces in the United States known to be using the pulverized coal.

At Harvard University ice has been produced at 375 degrees Fahrenheit—far above the ordinary boiling point—by subjecting water to a pressure of 40,000 atmospheres, equal to that 1,000 miles below the earth's surface.

RUNNING *the* ICE BLOCKADE



↑
To the rescue of ore boats caught in heavy spring ice in Whitefish Bay goes Coast Guard boat St. Marie (center)

Sketch (right) shows bow of cutter riding up over ice to break it with its weight instead of "cutting" by force

Below, measuring thickness of ice broken in Straits of Mackinac (24 inches) on ore route Duluth to Gary, Ind.



By Waring G. Smith

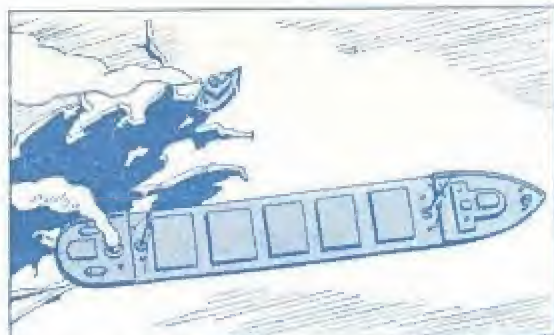
Ensign, U. S. Coast Guard Reserve

THE program of the United States Coast Guard to lengthen the navigation season on the vital Great Lakes shipping channels reaches a climax this year with the commissioning of the new "Manitowoc," probably the best ice breaker in the world.

It represents the culmination of decades of research and experience by the Coast Guard in ice-breaking operations, most of it in the Great Lakes region where hundreds of cargo ships carry the most concentrated shipment of ore in the world, and where the toughest ice-breaking problems exist.

Ore shipments originate in Lake Superior ports, meet the bottleneck of the St. Mary's River below Whitefish Bay, pass through the "Soo" locks and divide at Lake Huron. One third of the ship-





Ice-locked freighter in sketch is being freed by cutter circling ship. Right, the famous old three-masted Coast Guard cutter "Bear"

ments then pass through the tricky Straits of Mackinac to Lake Michigan; other shipments pass through the narrow St. Clair and Detroit Rivers to lower lake ports.

Some shipping experts claim it is possible, barring extreme winter weather, to keep Great Lakes channels usable practically the year around. But two factors prevent the attempt. First, a great part of the iron ore is mined by a hydraulic process not usable in sub-freezing conditions. Damp ore will freeze to the sides of a ship's hold, cannot be unloaded without passing the ship through a steam shed. Supplies of ore for winter shipments are limited to what is available from dry stock piles built up in summer months. Of course vessels han-



Official U. S. Coast Guard photos

dling oil, coal, timber, and scrap steel are not hindered by freezing weather. Sometimes they operate after ore boats have been laid up.

Second, and more important deterrent, is the law of diminishing returns. In winter

Plowing through a mountain of ice, the cutter St. Marie clears a channel through bottleneck of St. Mary's River below Whitefish Bay and above well-guarded locks of Sault Sainte Marie





Hard working crew clears ice from deck of cutter as the Coast Guard opens channel for boats on Hudson River in early spring

it becomes wasteful, even dangerous to carry on normal ship movements. More fuel and manpower would be spent keeping ice-bound channels open than the shipments justify. Danger of being grounded becomes greater. Ice damages the steel plates of freighter hulls.

Hence ice-breaking operations are intended to prolong the navigation season only when large fleet movements can be maintained. The ice-breaking program in 1941 was partly responsible for a total net tonnage of 89,730,000 in ore movements, surpassing previous records by 15,000,000 tons. In 1942 many new records were established. Soon after ice-breaking began on March 20 the ports at Escanaba and Marquette, Mich., opened at earliest-yet

dates. The first arrival in Cleveland, on March 28 cut 12 days off the earliest previous records.

The first spring operation is to break a channel in frozen harbors to coal docks where ships may refuel, then clear a path to open water. None of the Great Lakes freezes over entirely, except Lake Erie in severe weather. Huge ice fields form in shallow sections and bays, but a channel can be cleared.

Seldom does the ice get too thick to break. The *Sainte Marie*, one of the toughest ice breakers, can clear a path through four feet of solid ice. If a channel cannot be

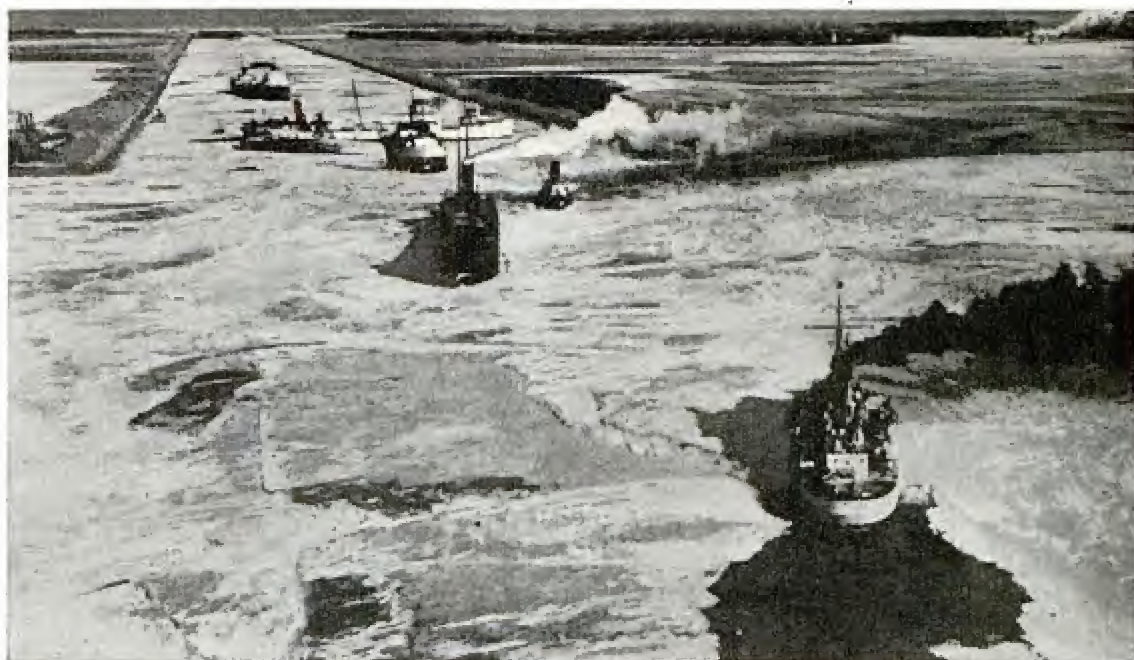
broken or maintained through a large ice field, lake captains wait for a change of wind to move the field clear of the course, rather than attempt to skirt a shifting field which may drive the ship dangerously near shore.

Slush ice, jams and windrows where ice has packed up in jagged barriers are the big problems. Granular ice has a heavy drag like quicksand, is responsible for the majority of cases where vessels get stuck.

On March 24, 1942, the tug *Iowa* was stationed in Whitefish Bay to free vessels progressing through loose field ice and slush ice. While following about 100 yards behind a freighter, pan ice closed in and caught the *Iowa* on her port beam, forcing her up on the field ice as large pieces

Pride of the Coast Guard—the new streamline \$6,000,000 ice-breaking cutter *Manitowoc* which has cruising range of 6,000 miles and carries airplane with gear for raising and lowering



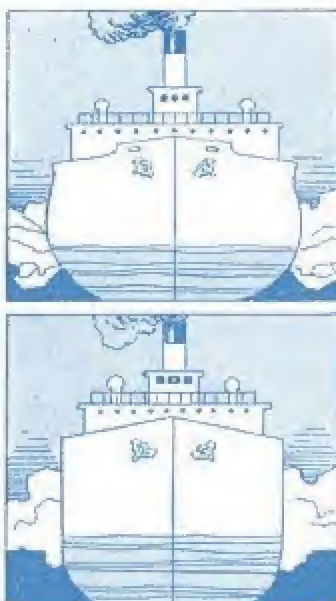


Egg-shaped hull of a new cutter at right guards against ice pressure better than vertical type, below

jammed against her hull and spilled over the gunwales onto her deck. She was freed by loosening the ice with the wash from the forward propeller of the *Sainte Marie*, a common method of freeing vessels.

Aerial reconnaissance often enables vessels to avoid windrows and large ice jams. Coast Guard amphibian planes radio reports on currents, large movements of ice fields, location of barriers. The plane's navigator indicates to the breaker the course where least resistance will be met.

Where windrows cannot be circumnavigated, brute force is used. The breaker will proceed into a windrow until the danger of getting stuck is imminent, then reverse and get a fresh start in another direction. By repeating this process, large pieces of ice can be broken off and washed astern by propeller action. The trick is to make progress but keep the stern free so a quick reverse can be made. As the breaker forges ahead, the captain must be ready for the moment when resistance nearly stops the vessel. If he fails to reverse her then, the bow will ride up high, then the ship will be stuck. Then another breaker



† Great Lakes freighters frozen in the narrow Detroit River are "rescued" by hardy Coast Guard cutters

must free her by cutting a semicircular channel along-side. In some cases, it may be necessary to use dynamite. The explosive charge is not so much to break up the ice as to create a sudden concussion which will momentarily free the hull. At this split second, the vessel can make a start to the rear and clear herself.

Ice jams present impregnable barriers. Fortunately they seldom develop entirely across a bay or channel but are driven to one side

or the other by prevailing winds. If the one navigable channel is blocked by a jam, the captain can only wait until a change of wind moves the ice aside.

Not always is it ice or storm that stops a ship. Great Lakes sailors still tell of the time when a horse and wagon held up navigation. A farmer had been traveling across an ice field at the north end of Lake Huron and became "mired" in the path of a freighter. It took several hours to free the wagon wheels before the command "full speed ahead" could be given on the freighter's bridge.

Prime requisites of an ice breaker are

(Continued to page 173)

Capt J. P. Lippert, 2200 7th Ave. Hills Ave
Oakwood, Dayton, Ohio

TOYS of WAR

11
1150
1150
Toys representing tanks, ships, guns and airplanes teach Uncle Sam's fighters the game of war that is played for keeps. At an army air corps combat crew school, right, scale models familiarize bomber crews with Jap and American battleships so enemy craft may be identified quickly



Widespread army installations need traffic officers well trained for the job. Miniature buildings and vehicles, left, present problems in controlling the movement of traffic and aid instructors in demonstrating their solutions. Below is a midget cutaway copy of army barracks, where embryo carpenters, electricians and plumbers of the armed forces get a thorough knowledge in the fundamentals of repair and construction. Scale models work like the real thing and speed up instruction



Among the "toys of war" is a tiny rifle range, complete in every detail and used for instructing gunners. Face of model rapid-fire target, left, is divided into 10 equal parts and the pointer is turned by handcrank as student practices firing. This helps the student when he goes to work on actual range

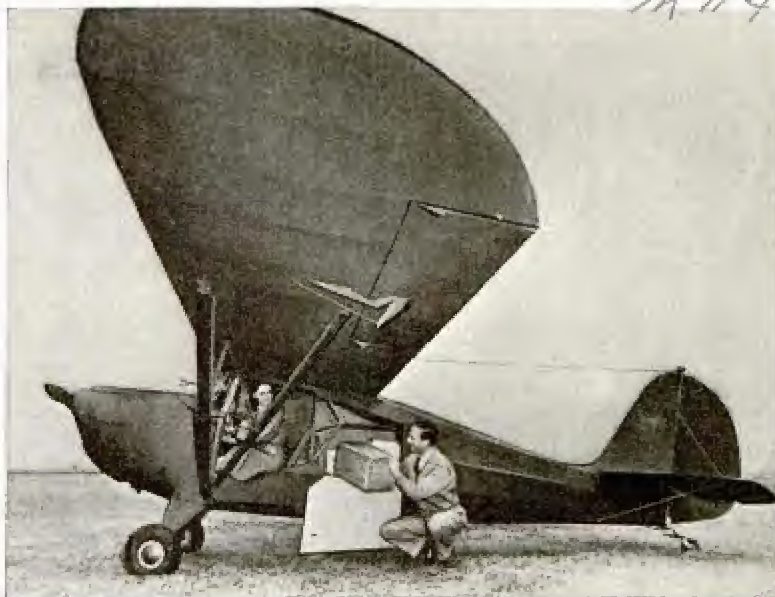
Photos, U. S. Army Signal Corps

Middlestown, Ohio

Light Plane Flies Vital Cargo to Isolated Spots

m 1147

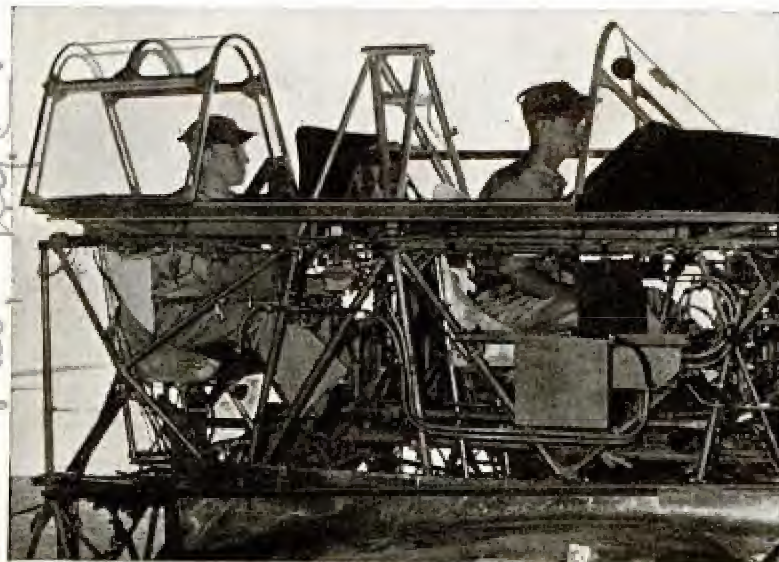
Small vital cargoes can be carried swiftly to regions inaccessible by other means in a new light plane which proved successful in recent tests by the Aeronca Aircraft Corporation. Fully loaded with freight such as fuel, ammunition, food and medical supplies, the cargo plane can land, take off and maneuver in an area too small for the larger and faster ships.



Small plane, capable of landing and taking off in small space, loads and unloads quickly through side panel

Skeleton of Disabled Trainer Teaches Use of Controls

m 1085



Remains of a damaged trainer do ground duty training cadets at controls

Although badly enough to be retired from further flying duty, an advanced training plane was not allowed to relinquish its useful life. At Southwest Airways' Falcon Field, Phoenix, Ariz., this disabled ship, grounded permanently, gives a preliminary orientation course to Royal Air Force cadets. To serve as a teacher, the ship's fuselage was stripped of nearly everything except dual pilots' compartments, instrument panels and controls.

United States Railways Double Use of Diesels in the Last Two Years

Use of Diesel locomotives by American railroads has doubled in the past two years, while the number of steam and electric locomotives has decreased, according to year-end records of the Association of American Railroads. Moreover, the number of new Diesel locomotives on order was greater than the number of both steam and electric locomotives combined. Diesel locomotives in operation numbered 1,486, a two-year gain of 770, while the number

of electric locomotives, 775, was a two-year loss of 12, and the number of steam locomotives, 39,245, was a two-year decrease of 816. On order were 504 Diesels, 314 steam, and only 22 electric locomotives. Of the new locomotives placed in service during the year, 319 were Diesels and 256 were electric or steam.

Ⓛ Brake linings of large bombing planes must be renewed after only six landings.

APRIL, 1943

Diesel Power & Transportation Jan 43

acme / Moore's. Inc. 2. re
461-8 av. 1942

"Club" Propeller Aids in Test Of New Airplane Engine



Airplane engine spins this heavy-bladed propeller during test run at the factory; its blades are shaped to cool the engine

In running tests of new Wright Cyclone engines built at the Studebaker plant in South Bend, Ind., club-bladed propellers are used to give the same load capacity as a flight propeller. The diameter being smaller, it permits tests to be run in smaller cells. Propellers are shaped to cool the engine while under test. After a severe initial test, each engine is torn down and inspected thoroughly, then reassembled and given a final test before leaving the plant.

Fingertip Control of Dental Drill Eliminates Foot Pedal

Fingertip control for the dental drill engine invented by Dr. Maurice I. Blair of Chicago will relieve dentists of the discomfort of standing awkwardly on one foot as they do with the foot-controlled drill. Since it was found impossible to place the control button directly on the drill, the inventor hit upon the idea of mounting a sensitive electric button on the mirror handle, connecting it by aerial wire to the drill through a two-tube radio. This is simple

to manipulate, and safe to use. It will not be in production until after the war, and by that time Dr. Blair expects to offer also a low-voltage switch to start and stop the dental engine, for use in areas where electrical interference might cause trouble in the radio circuit.

Mothballs Held in Hanger Protect the Garment

Carrying its own supply of mothballs, a garment hanger for which a patent has been issued to Sidney M. Abbens of San Francisco permeates the garment with moth-repelling fumes. In the hanger are recesses that hold the mothballs, vents being provided for escape of the fumes. Additional mothball space can be included by suspending a crosspiece between the ends of the hanger and cutting tapered openings into it to receive the moth repellent. A sliding perforated cover may be used on this bar to keep the mothballs from falling out.



Coat hanger loaded with mothballs has vents which allow the fumes to escape and permeate the garment

New Furniture Bounces on Wooden Springs

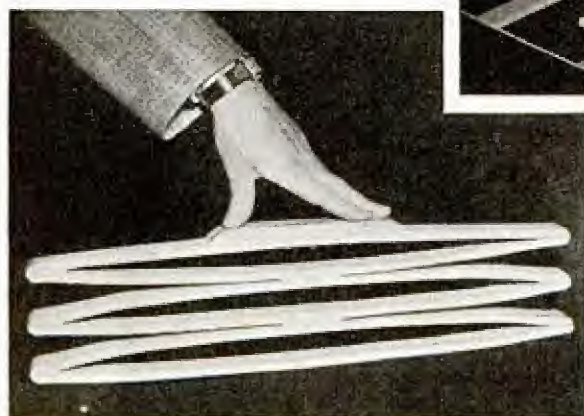
21157



Foregoing use of steel springs to conserve metal, the furniture makers have devised substitutes of noncritical materials, chiefly wood. Above, a double-conical coil, collapsing within itself, made from thin, laminated wood strips



"Bouncy" foundations for innerspring mattresses still in dealers' hands, and for the cotton felt mattresses coming into use, are achieved by a base made of wooden slats held in a bowed position by round wood blocks, shown installed on bed above



Several wooden springs like one above form the unit for a chair or sofa. To avoid steam bending, long ellipses are cut from a single plank, and narrow V's sawed from the ends. Ellipses are open at one end to relieve stress. "Individual spring action" of double-conical coils is claimed for spring at right. It is a series of ellipses, made of two pieces of bow-bent hardwood, held into a unit by strips of fiber. Waste bits of metal form the "joining hardware." Designers and inventors are constantly contriving new spring designs, in slats or laminations and a variety of shapes



Con: Keith Vining, carpenter's mate
Seabees, 40 Battalion 20, N.C.T.C., Camp

The NAVY'S FIGHTING



The Seabees are builders, but they're taught to fight, too, during a basic training course

Their emblem is a busy bee in sailor hat, firing a tommygun and carrying wrench and hammer

Members of a navy construction regiment make practice landing from surf boats "under fire"



m 1028
TOUGHENED by years spent in the mechanical trades, molded into the Navy way of living by regular Naval officers, coached in the latest methods of construction by civil engineers, and schooled in combat tactics by hard-boiled Marine instructors, the Seabees are well named.

Their nickname is a derivation of the initials **C.B.**—**C**onstruction **B**attalions. Their slogan is "We Defend What We Build," and the inscription, picturing an angry bee, portrays their two-fold purpose. In the emblem, a busy bee wears a sailor's hat; in his fore-hand he carries a tommygun, mid-ships hand a wrench and aft hand a hammer. On his corresponding sleeves are respectively: a Gunner's Mate rating badge, Machinist's Mate badge and a Carpenter's Mate badge.

Picked from among the best mechanics and technicians in civilian life, these men are becoming the unsung heroes of this war, for their work carries them right up to the battle fronts—and the nature of their achievements must necessarily be secret. They work right along with the Marines and begin construction before the smoke of battle has cleared away.

It is significant of the high cali-



Allen, Norfolk, Va.

"SEABEES"

ber of mechanics accepted in the Seabees, that 60 percent of them are rated third class petty officers or higher. Physical requirements are nearly as exacting as in the regular Navy, only 50 percent of the applicants being acceptable. Already numbering many battalions, the Seabees only commenced organization after Pearl Harbor.

Yankee ingenuity is here reaching new high levels. Engineers and mechanics alike are encouraged to develop new ideas. Although details of their accomplishments must remain a military secret, among them are a "packaged roadway" that may be installed faster than ground can be cleared for it, instantly usable for landing even the heaviest planes; barges, or pontoons that are made up of sections and reassembled into many other practical types of equipment; an ingenious propulsion unit, and such items as combination refrigerators and life rafts!

Let's accompany an imaginary Construction Battalion in action. The problem is to establish an



Seabees defend a beach head from a hastily built foxhole

Right, a navy trainee learns to operate a steam shovel



Building a road through Virginia sand dunes. It is made of 20-foot wire mesh sections welded together
U. S. Navy photographs





Once the Marines have seized a beach, Seabees move in to fortify it. Above, towing 4-inch gun on skids with bulldozer



A landing party at the Seabee training center works ashore from a motor sailer, careful to keep their equipment dry

Pontoon barge is driven close to beach, and here anchor is being dropped before putting construction materials ashore



advance base on Island "X," recently wrested from the Japanese. The enemy has inconsiderately left this island in a deplorable state. What little water there was has been contaminated; wharves, dry-docks, buildings are a mass of burning rubble. Only shallow draft boats may land, for the single channel through the reef is wedged fast with a bomb-shattered destroyer.

As the last of the enemy are "mopped up," a Marine semaphore sends a message to the transports standing by. Even while a Seabee wigwags the answer, huge cranes begin lifting rapidly assembled pontoon barges over the side. Some of these vessels, loaded with diving and demolition equipment, head for the blocked channel, others point for the beach. Shallow draft admits them over the reef, and soon they nose up onto the sand.

Ramps are built and bulldozers landed. While roads are cleared and graded, carpenters swiftly build forms for gun emplacements at strategic locations. Concrete is mixing even before the mixers are unloaded, and guns will be mounted in a few hours.

Trained details are laying "packaged roadway" as fast as the ground is cleared. Electricians set up large generating equipment to provide light and power. Barges are re-assembled into wharves and dry-docks. Machine repair shops are set up, for some ships will require immediate attention.

A heavy concussion shakes the island, and men look up only long

enough to see smoke, water and debris, rise in a mighty column over the blocked channel. Ships hoist anchor and head for the channel, for the sunken destroyer has been blasted away.

Ships tie up to the wharves and begin unloading heavy equipment. Huge stills are set up, and begin delivering hundreds of gallons of fresh water per hour from the sea. Well drillers go into action, and kitchen equipment hits the beach. A tent city mushrooms into being.

Camouflage experts disguise these operations as rapidly as they are completed. Not one bit of raw earth or one shiny tool will be left uncovered.

An air raid warning rings out. What was a beehive of activity, becomes in seconds a masterpiece of optical deception. The few enemy aircraft that evade our interceptors, look through their bomb-sights for a target. Suddenly they realize they are trapped, for cleverly concealed guns bracket them in a deadly ring of fire. More Japanese have discovered that Sea-bees sting.

A few days later "Quonset Huts," those portable barracks, begin replacing the tent city. Water flows from deep wells, is purified and replaces that from the stills. Permanent mess halls appear, and ice machines begin to freeze thousands of tons of ice.

The finest surgical and medical equipment accompanies the Sea-bees, and is set up in new buildings, to be used by top-notch physicians, commissioned officers from private life. Epidemic diseases will be unknown, and sickness at a minimum due to inoculation, and strictest hygiene. These men are valuable to Uncle Sam, and he really protects them.

In a surprisingly few weeks, the base has assumed the aspect of a small city. Heavy freight rumbles along its fine roads, and huge bombers line its runways. Softball diamonds and football fields,

(Continued to page 161)

APRIL, 1943

*Transportation Guarantee
35 Chelsey St
San Francisco, Cal.*
**Loading and Unloading Speeded
By Demountable Truck Body**



Demountable body is moved on or off truck chassis by one man

Greater speed in loading and unloading war goods is possible with a demountable truck body that slides along two tracks and has two casters to facilitate slipping the load off the chassis and wheeling it across the floor of the plant or platform. The body can be adapted to any type chassis, and only one-fourth the usual time is required for unloading. With the unloading gear specially arranged, one man can mount or dismount the heaviest load.

Lookouts on Rotating "Bicycle Seats" Scan Sea and Sky for Enemy

Pressing field glasses to their eyes, lookout men aboard U. S. warships sit in chairs called "bicycle seats" that allow them to circle completely as they keep watch over the sea and sky. Upon their keenness depends the speed with which the gunners can get into action against enemy craft.



"Bicycle seats" give lookouts a clear view in all directions

*Little News Photos
326 W. Madison, Chicago*

SKY SWEEPERS

on the ALERT



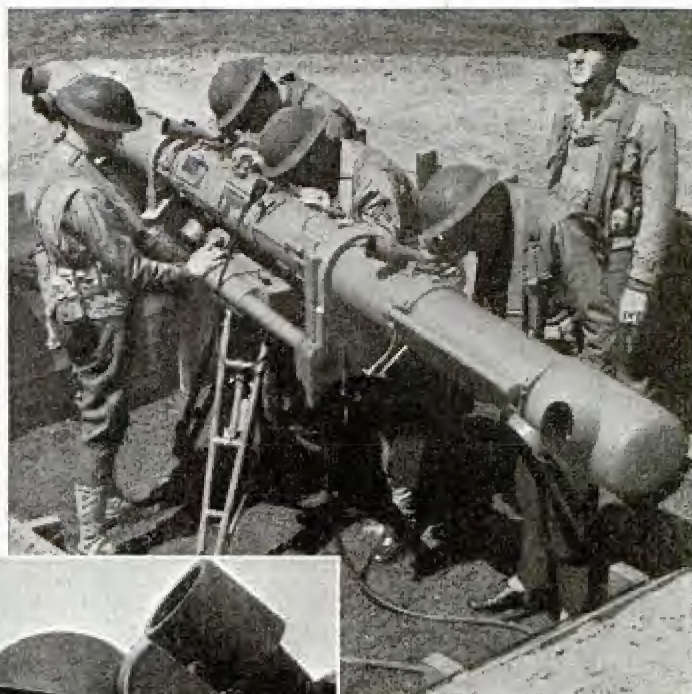
"Keep 'em falling" voices the grim task of our batteries engaged in raking enemy planes from the sky. An important weapon is the giant 90-mm. anti-aircraft gun, left. Its shells knock out high-flying enemy bombers, even crippling planes without direct hits because of their wide bursting zone. Above, loader of a 37-mm. rapid-firing gun carries clip of high-explosive shells effective against compara-

Searchlight operator, below, manipulates the controls that focus the beam on a plane



tively low-flying planes. "Ears," below, reveal approaching planes whether the visibility is good or bad, and help to "position" the searchlights at night





Wearing helmet and "stethoscope" attachments, above, specially trained man operates the "ears," or sound locator. All men in this branch must have binaural hearing so they can trace the origin of sounds. Through the battery commander's telescope, (center,) a constant watch is kept on the effect of the firing, enabling necessary corrections to be made quickly



Heightfinder, above, determines altitude of planes and is coordinated with the "director," which in turn transmits final firing data to guns after it has been calculated accurately. An important niche in a battery is filled by the .50-caliber heavy machine gun, below. It delivers potent wallops against low-flying enemy aircraft, such as dive bombers or planes on strafing missions



Int'l News Photos, 3.26
W. Madison, Chicago

Tree Sniper Is Almost Invisible In His Speckled Suit



Even the sharp eye of the camera shows little distinction between this sniper's speckled suit and the bark of the tree

Trying to make themselves felt but not seen by the enemy, snipers training with an air depot camouflage group try out varicolored clothing to conceal their presence from the sharpest eyes. One motley suit worn by a tree sniper near McClellan Field makes him almost invisible by blending his form with that of the fungi-covered trunk.

Joining of Metals in Alloy Visible By "Thin Film" Process

Something never before seen—the actual mingling of two metals to form an alloy—has been made visible by a "thin film" process developed by Dr. Howard S. Coleman and Prof. Henry L. Yeagley of the Pennsylvania State College. The process shows in seconds, or minutes at most, what formerly took months to learn, namely, how rapidly one metal spreads through, or

diffuses into, another. In the new process, the metals that form the alloy are vaporized and condensed, one on top of another, in layers on a glass slide. With the metals deposited on the back, the obverse side becomes a mirror, just as a glass backed with silver or mercury shows a reflection. The slide is then reheated until diffusion begins, and the progress of one film of metal into the other is measured by a photoelectric cell, which records the change of light density upon a recording ammeter. The lowered reflection is a measure of the speed of diffusion of the two metals.

Clamp With a Sliding Jaw Slips Quickly on Work

Easy and fast to apply when gluing small parts together, a wooden clamp now available has a sliding jaw that holds tightly when squeezed by hand, and releases immediately on pulling the "trigger." Handy for home workshops, the clamp will not mar delicate work and saves time in making wooden articles, patterns, musical instruments and novelties. They come in five sizes from four to 12 inches long, giving from 40 to 100 pounds pressure.

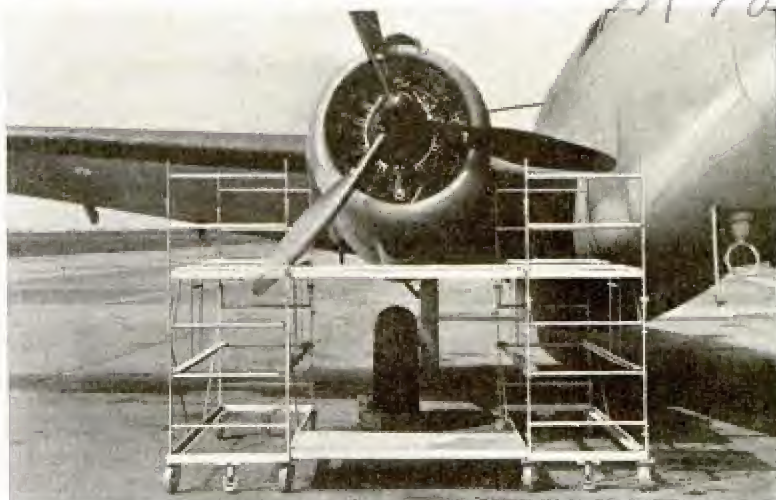


Alternate squeezes at top and bottom tighten clamp; a pull on the "trigger" releases pressure immediately

*W. J. Walfer & Mann Mfg. Co.
28th and Harrison Sts. Baltimore, Md.*

Adjustable "Catwalk" Helps Service Airplanes

For the convenience of ground crews that service airplanes, an adjustable scaffold may be extended to form a straight "catwalk" from which an entire wing can be reached, or assembled in U shape for work on the engines. Mounted on casters, the platform is easily moved, but there are four "feet" which lock it immovably on the ground in working position. Sections of the platform floor are hinged so they may be opened to provide a well for the propeller, permitting the engine to be tested without removal of the entire scaffold. When it is to be stored, it folds compactly and takes little space.



Folding scaffold, top, forms a catwalk at two sides and front of engine; bottom, it is adjusted in straight line along edge of a wing

Mechanical Cotton Picker Helps Conserve Manpower

After nearly 40 years in the development process, the newest type mechanical cotton picker is finding usefulness in the war ef-

fort as an important labor saver. Two International Harvester pickers working on a plantation near Clarksdale, Miss., have

released many toilers for duty at both the fighting and production lines. At present the operation of these machines is limited to areas where cotton gins are equipped with special cleaners and driers which have been developed for processing the mechanically picked cotton.

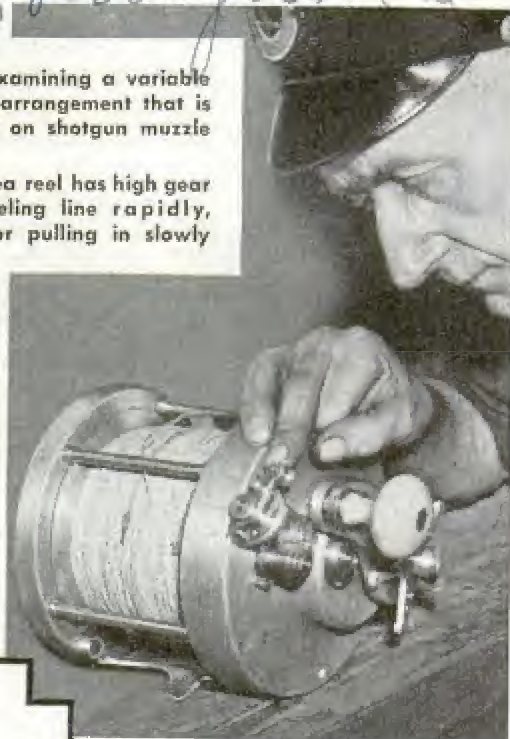


A pair of the latest type mechanical pickers heading through field in a recent test. The one in front, it is said, can do the work of 50 to 80 men. Portion of the field at left has been picked

Photo & caption for 38727 Franklin Ave Los Angeles Cal.



Left, examining a variable choke arrangement that is placed on shotgun muzzle



Deepsea reel has high gear for reeling line rapidly, low for pulling in slowly



FIRST AID

for GUNS and TACKLE

7M1026

Ref: By C. B. Harrison

Outing Expert

Automobile Club of Southern California

2601 S. Figueroa St

A GOOD JOB for you after dinner tonight would be to take your fishing lines off the reels and coil them loosely in a cardboard box for storage. Tie a piece of string around the end that comes off the reel first so you can reverse the line when you put it back on the reel.

Another after-dinner job is to take your gun apart, wipe it clean, and oil it. This should be done every month, not just once a year. Leave plenty of oil inside the barrel but don't plug the ends with oily rags. This common mistake promotes sweat and rust.

You won't be able to buy much in the way of sporting goods and tackle until after the war. Dealers are already sold out on many items. Now is the time to start taking extra care

Clamps are attached to the toes of skis to hold them at the proper curve when not in use



Los Angeles, Cal.

of what you own. Never allow a fishing line to dry on the reel. Strip off the wet line and let it dry thoroughly in the shade. If the line has been used in salt water, wash it several times in fresh water before drying. Hooks that have been used are sure to rust, so protect them with oil or grease when putting them away. Leaders should be dried and stored in loose coils. Rods should be hung by their tips. Don't lean them against a wall. It's a good idea to varnish them once a year. Your flies are safest when you put a mothball in among them. When you store away your reel, disassemble and clean it with kerosene, and after it has dried thoroughly, wipe all parts with an oily rag.

Guns are doubly valuable these days. When you go after game, make every shell count. Shells are scarce, and meat that you knock down yourself helps solve our food problem. Take a trained dog when you go bird hunting. A dog can nose out cripples that you would swear had gotten away. I got four fat pheasants one morning without firing a shot, simply by ranging across a field that had been shot over at daybreak by a group of hunters. They hadn't been able to find the birds they had crippled and my dog traced four of these.

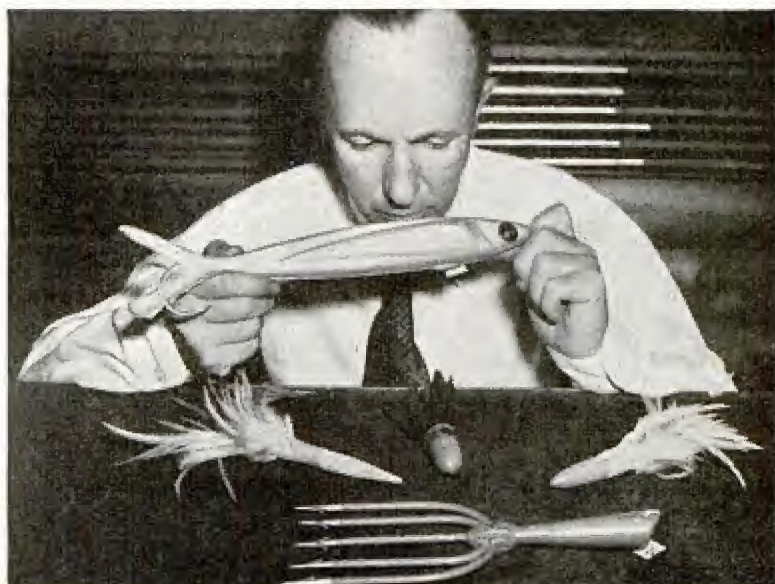
A dog loses his power of scent in dry, dusty hunting. Carry water with you and give him a drink now and then. That keeps his nose wet and allows him to work better. Your



↑
Here is a compressed-air harpoon gun used for shark fishing. Air is discharged into barrel behind the harpoon by means of electromagnetic valve

← Ocean fisherman's chair and reel made of Lucite plastic on aluminum alloy base. Rod butt is integral with reel, has chuck at top for seating rod

↓
Spear head, feather jigs and the rubber fish with a hook in its tail are part of the tackle one fisherman uses to catch big game of the ocean





Battery-driven outboard engine has electric motor in streamline housing in front of screw. Crank is for slow speeds

dog may travel ten times farther than you do when hunting and his muscles are knotted and sore at the end of the day. Before feeding him, brush his coat and knead his legs and shoulders.

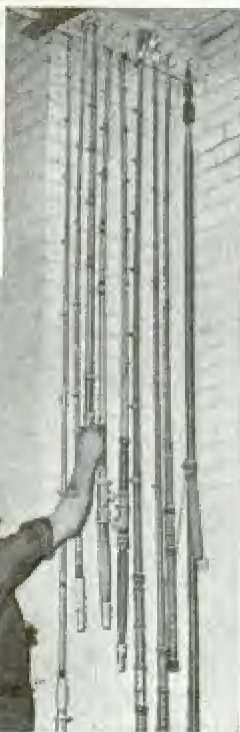
In the field, pick up all your used shells. Center fire cartridge cases can be reloaded. Even reloading materials are scarce, but many gun clubs have the equipment and some still have materials for reloading. If your local police department has a pistol range they probably reload their cartridges and may have tools and materials for your size as well. If not, they probably can tell you where to get the gear you need. Be sure to use the right materials. If you load shotgun shells with pistol powder, for instance, you are apt to blow up your gun.

A rifle or any other sort of gun can blow up with disastrous results if the barrel is plugged or stopped up. It's al-

ways a good idea to open the action and sight through the bore from the rear to make certain the gun is clean before taking it in the field. One man didn't know the barrel of his brand new gun was full of grease and he blew the gun to pieces and injured himself the first time he fired it. Snow has probably burst more gun barrels than anything else. A careless hunter gets a little snow packed in the muzzle, and another "hunting accident" occurs. Twigs or mud are just as dangerous.

If you are using old ammunition there is always a chance that a cartridge will hang fire. It may delay and not explode for 10

seconds or up to a minute after you have pulled the trigger. The best thing to do is to keep aiming at the target for at least 20 seconds. If it hasn't fired by then, point the gun at the ground and keep the breech closed a full minute before opening it up and extracting the cartridge. The big danger in a hang fire is that the shell may explode just as you are opening the breech. Another thing, never use modern high power shells in an old Da-



Left, fishing rods should be hung by tips instead of leaning against wall. Below, repaint decoys every season



masculus twist shotgun. Those guns are works of art, but the barrels won't stand the pressures of modern powder. Such a shell may unwrap the barrel or blow it to pieces. Don't do any dry snapping, or trigger pulling, without a shell in the barrel of a rifle or shotgun. That's a good way to break the firing pin.

Few gun barrels are perfectly straight. That's the reason why, when you get a new gun, you should sight it in. Fire it a few times on a target range to learn just where it points and you can become familiar with how the sights should be set and held. This sighting-in is advised because it is impossible to keep the long drill straight when a barrel is being bored. The gunsmith first bores the barrel out, then machines the exterior away in the same line as the bore. After that he may sight through the bore and rap the barrel a few times with a mallet to help straighten it.

A rifle bullet can do more damage at, say 100 yards, than it can only 10 or 15 yards away from the muzzle. The reason



This rifle has a split barrel that burst because of stoppage. In this case the hunter was not injured, but proper care will prevent such mishaps

is that the bullet is unstable when it first leaves the gun and it takes considerable distance to settle down to straight flight. First the tail of the bullet wobbles around, describing a circle, then the whole bullet takes on a small corkscrew motion. Finally the spin imparted by the rotation grooves inside the barrel takes charge and the bullet settles down to straight, even flight.

Few hunters or fishermen have thought of canning the meat they bring home,

(Continued to page 154)

Left, a good rubdown with saddle soap will preserve leather goods. Right, reloading tool that seats new bullet on used cartridge case after new primer has been installed and powder poured in



Acme Newspictures Inc
461-8 av. nyc

"Traffic Cop" Directs Crossing at Plane Plant

M 1148



Vehicles scurrying between plants of airplane firm are aided by "traffic cop" at busy intersection

Acme Newspictures Inc
461-8 av. nyc
Traffic is so heavy at the Boeing Airplane Company's plant at Wichita, Kans., that a guard is posted to prevent tie-ups at the intersection of two busy lanes. Among the wide variety of riders and vehicles are

messengers toting light parcels, large semi-trailer trucks, smaller flat-bed trucks, and a sidecar motorcycle bearing a guard as he travels from one sentry post to another or does liaison work between plants.

Pre-Flight Glider Trains Student Without Leaving Ground



Student learns proper use of plane controls in pre-flight training glider which is towed around field by automobile

M 1092
Students learning the basic principles of flight can be spared the risk of a crackup by "flying" a glider that never leaves the ground. Seated at the controls, the beginner may acquire what amounts to experience in handling a plane in actual flight, while an automobile tows the pre-flight training glider on a level field in utmost safety.

Dive Bomber Seat Saves Pilot From "Blackout"

M 1093
Pilots in dive bombers will be able to pull out of their dizzying plunges with less chance of losing consciousness from violent and

sudden changes in blood circulation in their brains, if promises held out by an automatic pilot's seat, patented by Frederick P. Dillon of Los Angeles, are fulfilled. A hinged back tilts to let the pilot down to a supine position just before the plane reaches the most critical point in its dive. As the plane climbs out of the dive, a hydraulic cylinder automatically restores the seat to normal sitting position. The invention includes a gyroscopic mechanism that takes over control of the plane at the instant the pilot releases his bomb, maintaining automatic flight until the danger of "blackout" is past.

Sapper's "Divining Rod" Locates Buried Mines

Digging up land mines and rendering them harmless is the task of mine sappers whose work demands a high degree of skill and plenty of courage. First it is necessary to locate the hidden monsters. For this purpose the British army in Egypt and Africa has used a special detector, the construction of which is a guarded secret. Mounted on a long handle, the detector is swept over the ground ahead of the advancing troops, and when it comes within range of a bomb it sounds a warning in ear-phones worn by the user.



Detector, at left, finds mines, and sappers dispose of them

Portable Lights for Landing Field Made in "Backyard" Shops



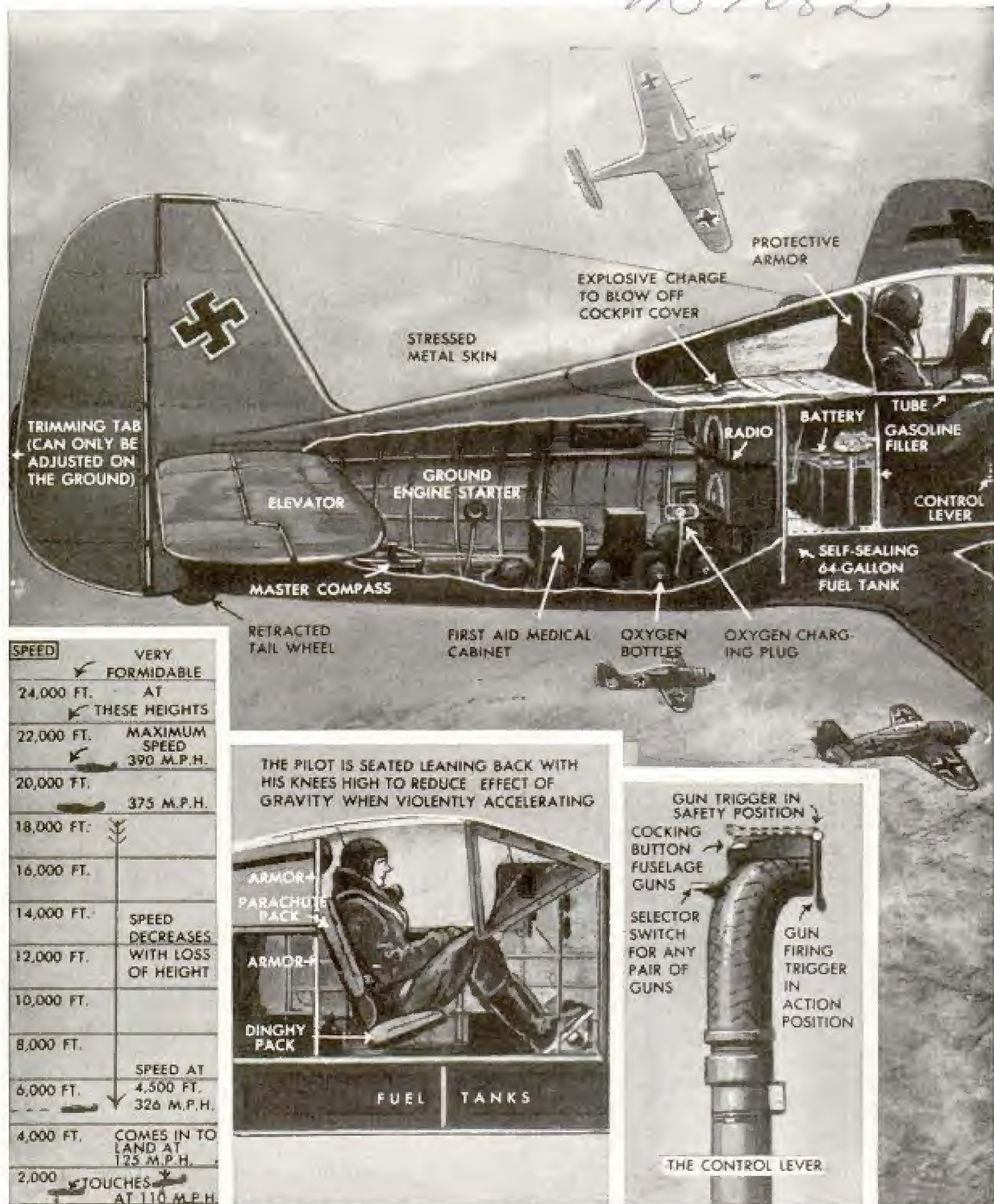
Lights made in many small shops are assembled for inspection

Hundreds of portable landing lights produced for the Army Air Corps in garages and backyard machine shops are brought together at the plant of Lights, Inc., of Los Angeles for checking by army inspectors. Acting as a clearing house for production of small-size articles needed by the army and navy, this company has opened up vast untapped resources offered by 450 small sub-contractors in its vicinity—backyard plants, machine shops and garages. These small shops are capable of manufacturing materials that would require a single plant of from 10,000 to 15,000 workers and from five to ten million dollars worth of unobtainable machinery.

Ⓐ new 3,000-ton Danish freight ship is driven by a 950-horsepower Diesel engine using producer gas instead of oil, the gas being generated aboard ship by burning coal.

R. A. F. Tries Out a Downed German Fighter

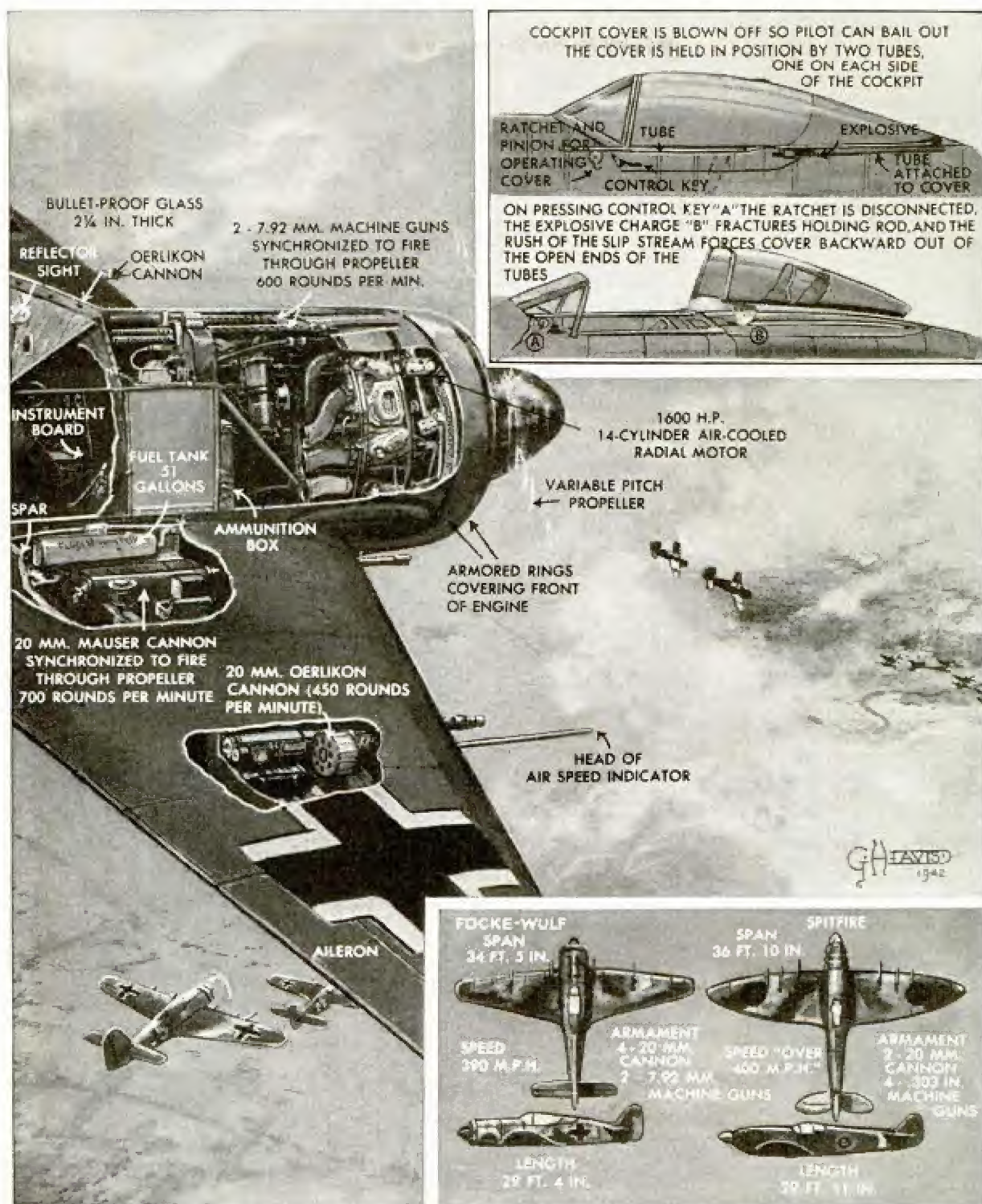
*London Daily Express Agency
1-2-41
M 1082*



Although a great fighting plane, tests of a German Focke-Wulf "F.W. 190," which landed intact in England, reveal it to be somewhat less than the phenomenal ship at first believed. At its best in altitudes between 20,000 and 24,000 feet, where it

reaches top speed, the sky fighter is formidable only above 16,000 feet. Drawings above indicate other interesting and outstanding features, and the inset, extreme lower righthand corner, shows some comparisons with Britain's Spitfire. Although

Pilot "Blows Up" Hood of Cockpit to Bail Out



the electrically operated undercarriage is rated among the best, aerodynamically the ship is poor, being hard to fly owing to its high landing speed. Provisions for the pilot are good. He can bail out quickly by jettisoning the whole cockpit hood at pres-

sure of a key. Total weight of fire from the four cannon and two machine guns amounts to about 610 pounds a minute, but is less effective than might appear because of the short machine-gun range and poor hitting power of the Oerlikon cannon.

Acme Newspictures Inc

461-8 av. n.y.c.

Air-Propelled Boat Rescues Flyers on the Nile

7-11-38



Driven by an air propeller and riding on pontoons, rescue boat is efficient in deep or shallow water

Sky fighters down on their luck and forced to land in waters of the Nile delta depend for quick rescue upon a hydroplane operated by the Royal Air Force. Skim-

ming over the surface on seaplane floats, the craft receives power from an airplane engine and an air propeller mounted at the stern. Top speed is about 15 knots.

Plane Model With Control Stick Shows How It Is Flown

Aviation students can now obtain a "build-it-yourself" airplane model of the P-39 Airacobra with cockpit controls that operate ailerons, rudder and elevator just

as on full-size craft. With it the builder interested in preflight training can "take the stick" and adjust the controls to the proper position for various maneuvers as shown in an illustrated booklet accompanying each kit. All of the parts, made of non-critical materials, are in finished form and need only to be fitted together, which can be done in 90 minutes. The tiny trainer has a 24-inch wingspan.



Wiggling control stick on airplane model, built from complete kit of parts, operates the rudder, elevator and ailerons as on an actual plane

Aviation Mechanics Learn Commando Tricks



News Bureau
You won't find the exercise (above) in the mechanics' manual for the army air forces, but the men in training at United Air Lines' School of Aeronautics learn that excellent physical condition may play an important part in getting a plane aloft in a hurry. Soldier mechanics drill on a 100-yard obstacle course

Chicago



Army mechanics don't stop for anything like a wall (above) if it happens to be between them and their planes. It's up and over in drill at Oakland, Calif.

Above, three mechanics take a hurdle on the "commando" course which is laid out on rough terrain with plenty of loose rock and sand surfaces such as might be found at an air field in distant combat zone. The course boasts one seven-foot wall, barbed wire entanglement, maze of poles and a deep pit spanned by a single log. At end of course (right) mechanics swarm about planes getting them under a shelter or ready to take off. The record time for the course is 18 seconds



Ref: Public Relations Dept
Dorminal Island Cal.

SHAKEDOWN CRUISE



Shipbuilding has undergone a revolution; vessels today are built in parts and then assembled. Here an entire deck section is lifted into its place by cranes

Propeller and rudder of a new Liberty ship ready for the launching. Soon the screw will be turning at full speed in a six-hour steam trial at the dockside



77 1035
By Thomas E. Stimson, Jr.

LIKE to go aboard for the shakedown cruise on one of America's brand new Liberty ships?

All right. Here's one at the California Shipbuilding Corporation's yards at San Pedro. Steam is up and the propeller is already turning over slowly as we show our passes and climb the gangplank. A few weeks ago this ship didn't exist; today she is complete in every item. Tomorrow she will be loading cargo for our forces in Europe or the Orient

Right now the vessel is about to begin her steaming trial. Full speed ahead for six steady hours. The ship trembles a bit as her propeller thrashes over faster and she strains against the hawsers that hold her in the dock. When do we cast off? We don't. The ship will stay tied to the land for this sea trial. Ordinarily we would be making the run at sea but an officer explains that the Navy is too busy just now to furnish a protective escort.

Early tomorrow morning the vessel will make a harbor run to test her maneuverability. Inspectors will measure the time it takes to swing her head to port and star-

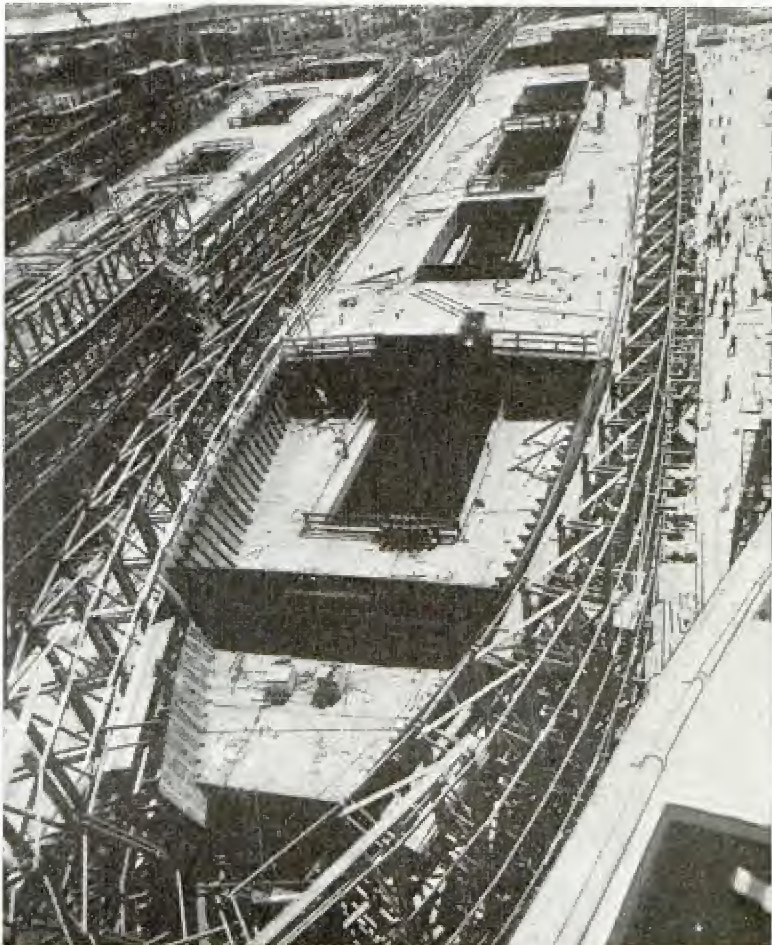
board, both going ahead and going astern. She will drop her anchors and pick them up. Then will come the crucial "crash stop" test in which the engine is thrown from full speed ahead to full speed astern as fast as the engineer can wind down the throttle wheel. The purpose is to see in how short a distance the ship can be brought from full speed ahead to a dead stop. The superstructure shakes and groans as the propeller goes into reverse. White water piles up under the stern and the ship loses way and stops.

Later, an hour or so is spent adjusting the compasses and checking the radio installations and the ship is returned to a pier. Even while the experts of the trial board are filling out their reports, her brand new canvas hatch covers are pulled off and the cargo booms begin to bring war materials on board. Provisions for her first voyage are trucked to the wharf, the balance of her crew are signed on, and the old broom at her masthead that shows she has passed her trials is hauled down. The vessel is ready to sail.

The 10,500-ton Liberty ship Joseph N. Teal was delivered to the Maritime Commission, ready to go to sea, two weeks to the day from the time her keel was laid. Similar vessels since have been built in less than a week. These remarkable records were made at the Henry J. Kaiser yards at Portland, Ore., and were made possible by the prefabrication of large sections of the vessels that



Above, swinging a gun aboard a Liberty ship. Hundreds of American cargo vessels are being armed against the U-boat raiders that infest the sea lanes and enemy planes that sweep out from Europe. Navy-trained gunners man the weapons. Below, Liberty ships at California shipbuilding yard





Above, the main switchboard in engine room of a Liberty ship

were then moved into place on the ways by tremendous cranes.

The technique of assembling ships by sections is still growing and the goal of shipbuilders is to prefabricate and preassemble even larger sections. For instance, the superstructure of a Liberty now takes a couple of days to move into place and assemble. The builders foresee the time when this entire amidships superstructure, consisting of armored bridge, navigation and radio quarters, offices, galley, and sleeping quarters, will be assembled on the ground in one huge complete unit, then picked up by cranes and dropped into place on deck. Then it will be necessary only to weld the great unit to the ship, paint over the fresh welds, and connect up the pipes and electric wiring.

A ship is far from complete on the day she is

launched. Most of her machinery, including the engine and boilers, is in place, but none of it is connected up. The launching ceremony is hardly over when tugs nose the new hull into the wet basin and the outfitters take charge. The outfitting crews have a million and one jobs to perform and each detail must be done just right even though the men are racing against time. The first big job is to line up the tail shaft with the boring of the stern frame. The shaft bearings are set up, chalked, and shimmed, the thrust bearing is lined up and adjusted and finally the main engine is lined up with the shaft.

Meanwhile, other outfitting crews are completing the installation of the water, steam, air and oil lines. Inspectors are right behind them, giving each tank and pipe line a hydrostatic test. Crews of



Skid frame (left) holds life raft poised ready to slide into water at instant rope is cut. Below, outfitting engineers line up propeller shaft with boring of frame



joiners are busy in the superstructure, finishing up the carpentry work, installing doors and bunks, running electric cables, and fitting out the galley. Electrical inspectors test each generator and switchboard as soon as it is connected up. Shipwrights meanwhile have been installing the anchors and anchor chains, and riggers have brought the booms and cargo handling equipment on board and are installing them in place. The life boats and life rafts are swung up on deck and tested for quick operation.

Now the navigation equipment is brought on board and attached to the ship. The radio, radio loop, depth finding equipment, compasses and binnacles, steering gear, navigation and signal lights, and flags are all made ready for use. The engine room telegraph is connected, the telephone system is installed, and the deck guns and other protective equipment are put in place. Twenty-four hours a day the work goes on. Has the typewriter been put in the radio shack? Has the rules-of-the-road chart been hung up on the bridge? Not one detail must be forgotten, from the installing of screens across the ventilators and the hooking up of the anti-magnetic-mine belt to the installation of the tiny davit on the bow to which the Suez light is to be attached any time the vessel goes through the Suez canal.

By the time bedding has been installed



Deck officers hoist an old broom to the masthead of a Liberty ship, signaling successful finish of sea trials

in the bunks, silverware and dishes have been placed in the galley, and the final painting is being completed, Calship's port engineer and his crew come on board. Members of the Maritime Commission trial board accompany him to test and prove the ship. The boilers are fired, steam is raised,

(Continued to page 156)

Beyond the aft gun platform of a Liberty ship, three other vessels of identical design are being completed
Photo from U. S. Maritime Commission



326 V. Mason, Chicago

"Para-Canine" Earns Wings By Repeated Jumps

M 1149



Mascot at Fort Benning making a "four-point" landing after leap from plane. He weighs ninety pounds

After making five regulation parachute jumps, Max—full-fledged mascot of the 505th parachute infantry at Ft. Benning—has been given his silver wings by Col. James M. Gavin. His first jump was taken in the number two position right behind Lt. Clyde Russell, who was jump master. It's said that all paratroopers sweat on the second leap, and, although he was no "door-freezer," the 90-pound canine toughie seemed to experience nervous reactions that were almost human. Ensuing jumps were taken in style, which qualified him for the 'chutist mascot rating.

Cement and Wood Fiber Mixture May Build Future Homes

M 1184

Building material made from a mixture of cement and a specially ground wood fiber is being studied by Robert C. Brown, Jr., director of the Chicago technical development section of the War Production Board, for possible use in building low-cost homes. The fiber, made from lumber

waste or inexpensive woods, is mixed with ordinary cement to form a material called "fibercrete," which weighs one-half to one-third as much as concrete and has two or three times its tensile strength. It can be sawed, is resistant to fire, is less brittle than concrete and absorbs less water than concrete. Most significant wartime application of fibercrete probably would be in runways for heavy bombers and for rapid construction of shelters at military bases.

Asbestos Gloves Are Air Cooled For Handling Hot Lamps

Sealed-beam headlamps carried out of an annealing furnace on a moving conveyor at the Westinghouse Company's lamp division in East Pittsburgh are so hot they scorch hands even when protected by asbestos gloves, and something had to be done about it. One day a department employee, getting a permanent wave, noted the beautician using an air hose to cool her hair. Borrowing this "air-conditioning" idea, a low pressure air hose was extended into the gauntlet of each glove to provide circulation of cool air, which carries off the heat. Besides ending the scorched-hand hazard for operators who remove the lamps from the conveyor, air circulating inside the gloves gives less shrinkage in the lamp glass because it permits change in the pre-heat temperature.

306-Have,



Low pressure hose extends into each asbestos glove with cool air to prevent burns on hands of worker

Acrony 1161- Soc, N.Y.C.

Sailors Ride Ack-Ack Mount to Learn Gunnery

In a four-month course ordinary seamen are turned out as antiaircraft gunners at a naval training school in England for service on board merchant ships. They start their training at the sights of an antiaircraft mounting, minus the gun, which has been erected at the seamen's school.

British seamen at sights of antiaircraft mounting at naval training school where they learn to man guns on merchant vessels



Self-Propelled Tank Destroyer Blasts 'Em With a "105"



Among the bad news for the Axis powers is a new self-propelled tank destroyer that has already gone into action for the U. S. Army. To rip the enemy's armored equipment it packs a vicious 105-millimeter gun, and also carries an anti-aircraft gun for defense against strafing planes.

Antiaircraft gun gives this lethal machine protection against enemy planes while it trains big center gun on foe

Wrap-Around Clamp for Hose Snaps Into Place With Leakproof Grip

Snapping easily into place with a twist of the wrist, a hose clamp now available saves bothering with nuts, threads and pivots. After a simple adjustment, the wrap-around clamp locks itself with a secure and uniform grip. Made of stainless steel resistant to erosion and material fatigue, the clamp is suitable for application to fluid supply hose that must be connected firmly to end assemblies, metal hydraulic lines, or even the garden hose. It may be left in place or used over and over again.

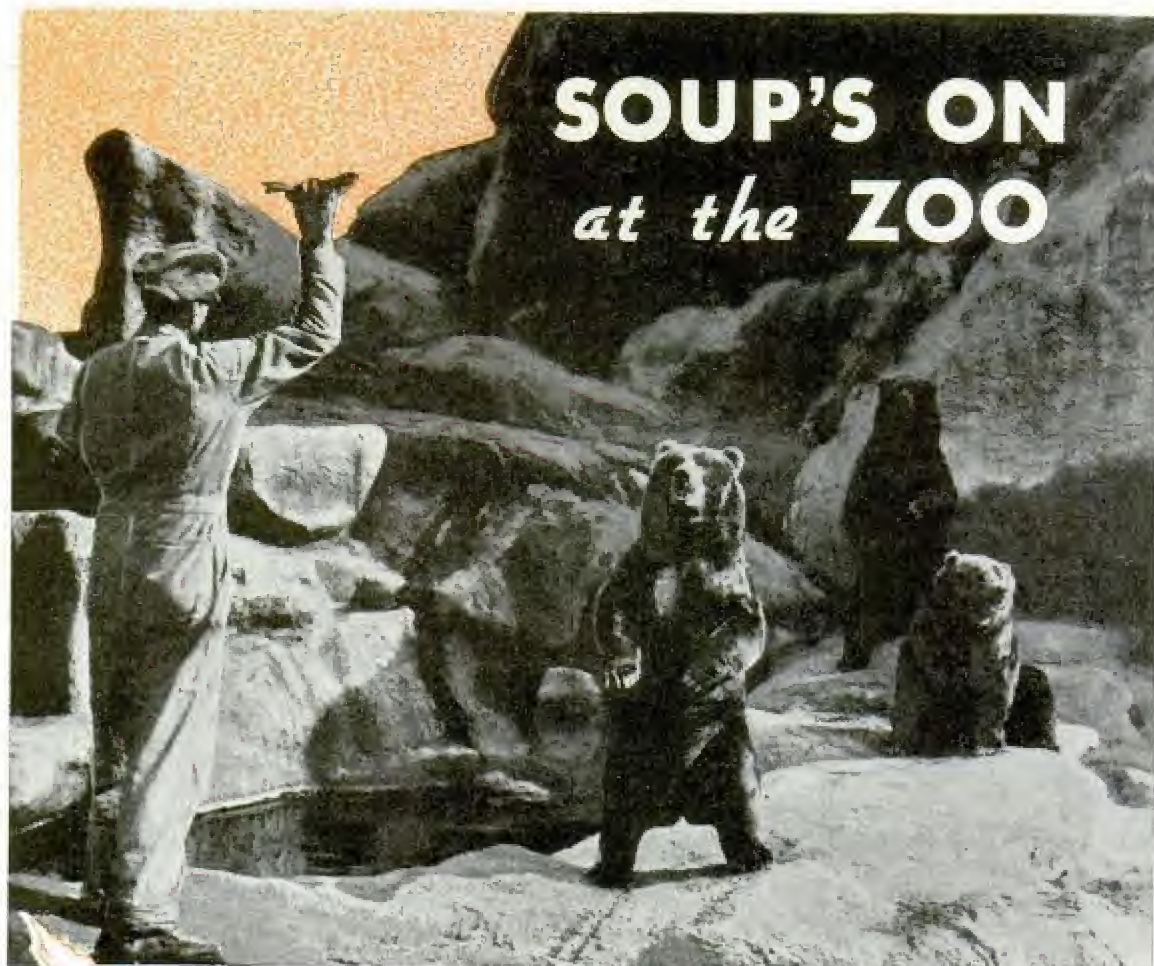
Connecting hose with steel clamp which snaps on in jiffy and locks with uniform pressure



APRIL, 1943

*Huntington Precision Products
Huntington, Va.*

81



SOUP'S ON *at the ZOO*



Last call for breakfast (herring and dog food) brings trio of 1,800 pound kodiaks to attention

"Ah," roars Bebe, giant hippo at Chicago's Brookfield Zoo as keeper literally tickles her palate



By

Wayne Whittaker

PALATES that must be tickled every day at the zoo range from gorilla to hummingbird; from the binturong of Sumatra and the giant panda of Szechwan Province, China, to the polar bear and the penguin.

A blueprint for feeding a zoo full of mammals, reptiles and birds from every corner and climate in the world is as intricate as plans for an ocean liner. When the curator makes out his menu it includes more than a hundred separate food items. Among the strange ones are blue clay for the kangaroos

and thistles for the camels. The anteater, whose name suggests a simple diet, won't touch ants. He prefers a porridge of milk, green bone paste, bananas, defibrinated blood, sweet potatoes, eggs, cod liver oil and almost everything within reach except the bars of his cage.

Other animals and reptiles have individual idiosyncrasies that complicate the bill of fare. Robert Bean, curator of mammals at Chicago's Brookfield Zoo and recognized in the zoo-keeping world as an authority on the care and feeding of wild animals and reptiles, recently had a python "personality and food problem" to handle.

The zoo was presented with a pair of valuable pythons, giant snakes of the earth, by a wealthy sportsman who had raised them on his estate.

"The only trouble with the pythons was that they wouldn't eat," said Mr. Bean. "After several months we became worried. We'd tried everything we could think of—choice fat rabbits, chickens, ducks and other poultry—but the pythons just pushed back their plates. Finally, I called the man who gave them to us. He told me the pythons had been raised on chickens and always had good appetites.

"Snatching at a straw, I asked him what kind of chickens he raised on the estate. He said White Leghorns. At that time we happened to be buying Plymouth Rocks and Rhode Island Reds. Well, I went out and rounded up some White Leghorns.



Leaning over a 14-foot fence, Jack the giraffe nibbles on a tasty leaf



Bottle-fed Joey (year old kangaroo) was tiny as mouse when "adopted"

This hungry resident of primate house, below, helps himself as keeper holds tray of fresh fruit and lettuce





Karonga, believed to be the only tame rhinoceros in world, accepts rye bread from her Brookfield keeper. Most rhinos are ferocious



Five-day-old zebra colt (above) takes time out for dinner as its mother, Maude, pricks up her ears at cameraman. Below, anteater with elongated snout sips a bowl of porridge containing milk, bananas, green bone paste, eggs, etc. He turns up his nose and refuses ants



You should have seen the pythons gobble them up. What they were doing was holding out for their favorite leghorns and they've thrived ever since. The python, by the way, is a quiet and good tempered fellow. He sleeps most of the time, rousing himself every two or three months to shed his skin and eat a meal."

The poultry connoisseurs of the reptile house are a far cry from the bears and hippopotami—the easiest animals to keep and feed. The bear is the most omnivorous of all wild beasts, relishing and thriving on meats, fish, fruits and vegetables alike. He breakfasts on dog biscuits and carrots; supper consists of several loaves of whole wheat bread, apples, fresh fruit, more carrots, meat or fish. Between-meal snacks, provided by the public, may include a dozen boxes of candied popcorn and 10 bags of peanuts. Wild animals will never overeat like their domestic cousins, according to Mr. Bean, and that is why the public is permitted to feed them indiscriminately.

The huge 1,600-pound kodiak bear consumes about 35 pounds of food daily during the summer and averages less than three pounds a day in winter. Like other bears, he will sleep for two or three days at a stretch in winter. Mr. Bean belongs to the school of thought that says no bear hibernates.

The hippo lives on mountains of alfalfa, oat and bran mash, chopped roots and greens. A sick hippo is an unknown quantity—a quantity of some 4,000 pounds.

Another zoo giant with a tremendous appetite, but lacking the hippo's excellent health, is the elephant seal. This 3,200-pound aquatic can polish off 100 pounds of mackerel daily during the warm

months. Plague of the big seal is ulcers. Reggie, the late elephant seal at Brookfield, used to go on a voluntary three-week starvation diet every summer to clear up his ulcers.

A giant panda cub is fed like a baby on milk, strained vegetables, corn sirup, cereal, halibut oil and malt. As he grows older, spinach, chard, celery, carrots, apples, toasted whole wheat bread, green cornstalks, bamboo and corn meal are added to the diet. A panda will never touch meat or fish.

Of the few pandas exhibited in this country, the Brookfield Zoo has had three. Mr. Bean, who pioneered in concocting a diet for panda cubs with the famous Su-Lin, believes the reason pandas die in American zoos at an early age may be traced to the rarefied atmosphere of their native habitat. A panda's lungs are half again as large as those of an American bear the same size.

Zoo keepers had difficulty in raising kangaroos, too, until it was discovered that clay from deep tunnels or river banks is essential to their diet. Without it they

develop a jaw disease that is often fatal.

"Our group of 42 kangaroos eats 100 bushels of blue clay a year," said Mr. Bean. "I don't know why it is good for them, but it is—perhaps some mineral content."

Don't get the idea that kangaroos live on clay alone. Their hearty diet includes rolled oats, whole wheat bread, chopped apples, sugar beets, carrots, boiled pota-



Robert Bean, curator of mammals at Brookfield, offers four-year-old panda, Mei-Lan, a bouquet of bamboo which she eats like hay

"Every man for himself" is polar bears' motto as they line up while a keeper pitches food. Note deep pit





Shoebill stork opens up to receive his breakfast herring that will be followed by a few smelts and frogs. He's from the Sudan

toes, bananas and plenty of leafy clover.

Brookfield's 700 animals consume more than 100,000 pounds of frozen horse meat a year. Frozen meats and fish are considered the greatest safeguards to health. The biggest meat eaters are tigers and lions, each grown animal devouring between 12 and 15 pounds daily. Another member of the cat family with a fondness for meat is the binturong, or "bear cat," who spends his non-eating moments snoozing in a tree.

Among the hay and grain consumers are the zebras, elephants, camels and giraffes. The zebra is a lazy fellow who is content to chew his alfalfa quietly unless it happens to be snowing. Despite his African habitat, the zebra has a childish urge to romp in the snow. Camels prefer the coarsest kind of hay. Dried thistles, resembling bouquets of needles, are camel delicacies. The giraffes, browsers by nature, prefer leafy alfalfa and the leaves of oak and maple trees. Giraffes also are fed milk and a porridge of oatmeal, corn meal, molasses and salt. The rabbitlike hyrax, or

Friendly Miss Congo, eight-year-old gorilla, sniffs at offering of candy

coney, becomes nervous and anemic when dandelions are omitted from his feed box.

The daily ration for the monkey family—rhesus, chimpanzees, gorillas and some 30 other variations of the clan—includes fruits, cereals, vegetables, spinach, lettuce and soy beans. The smaller species also relish insects and a little meat, but the larger the animal the less carnivorous he is. Gorillas loathe the sight and smell of meat or fish. If a gorilla becomes obstreperous, a fish dangled on the end of a stick will send him quaking to his cage. Gorillas love coffee and fruit. When Suzette, a member of Brookfield's gorilla family of three, recently had pneumonia she existed on a mere three dozen oranges and a pint or two of coffee a day.

All zoo animals are given cod liver oil in winter. The monkeys receive it the year around—not because they need it, but because they develop an intense dislike for it if removed from their diet during the summer. The monkeys are notorious "apple shiners" and learn to ingratiate themselves with their feeders in the hope of an occasional tidbit.

The big snakes live mostly on rabbits and poultry. The two pythons with a taste for White Leghorns are not the only residents



of Brookfield's spacious reptile house with diet eccentricities. An anaconda once refused food for 11 months. One day a truck driver ran over a cat. Apparently it was what the big South American boa was waiting for, because his menu since that day has had only one item—dead cats.

The boa-constrictor, who seeks his natural prey in jungle treetops, has a preference for pigeons or any tree-roosting bird. The big cobras (Grandpa cobra is 18 feet long) are satisfied with a dozen rats about every six weeks. Their neighbors, the alligators, dine on fresh meat and fish.

Feeding 1,200 birds of some 400 species is the job of Curator Karl Plath at Brookfield. The small softbilled birds consume a great variety of seeds—hemp, millet, rape, sunflower—and grain as well as bananas, apples, boiled sweet potatoes and grapes. Satisfactory substitutes have been found for many seeds formerly imported.

The birds eat more in proportion to their weight than any other zoo creature. The expression "birdlike appetite" is a misnomer, says Mr. Plath. Some of the larger birds, shoebill storks and penguins, are fed fish. The penguins receive one drop of iodine a day which helps them fight mold particles in the air. The mold causes painful corns on their feet and that is why they walk with an exaggerated waddle.

More difficult to feed than the bird of paradise and the exotic birds of the tropics are the tiny North American hummingbirds. They are fed a mixture of butter, scraps of lean meat and defibrinated blood.

In a single year the zoo's big commissary handles 109,000 pounds of frozen meat, 106,000 pounds of bear bread, 3,510 dozen eggs, 72,000 pounds of bananas, 47,000 pounds of apples, 39,000 pounds of carrots, 18,000 pounds of spinach, 13,000 pounds of mackerel, 187 tons of alfalfa hay, 114 tons of timothy hay, 40,000 pounds of bran, and 79,000 pounds of oats. Among scores of other annual food totals are 405 skinks (small lizards), 214 chameleons, 1,285 frogs, 2,500 pounds of canary seed, 45 pounds of thistle seed, five quarts of worms, 7,000 mice, 15 pounds of ant eggs, 200 pounds of yeast, 4,000 pounds of grapes and 180 gallons of cod liver oil.

Another large item is peanuts—for the public. On a busy day, 1,800 pounds are sold on the bear "promenade" alone. Mr. Bean estimates the bears' share is less than 10 percent.

APRIL, 1943

Crystals Crated With Motor Show Moisture It Absorbs



Blue crystals mean moisture has not reached engine

To detect any moisture encountered by Wright Cyclone engines while in transit between factory and destination, a bag of silica gel crystals, pasted on a color chart, accompanies each one as it is shipped. When the case is unpacked, the color of the crystals is matched with the chart. If the hue is pink, inspectors examine the engine to learn whether the moisture has affected the power plant. However, if the crystals correspond with the dark blue portion of the chart, it is a sure sign that all is well within the engine.

Groove Cut in Nut Saves Steel Without Loss of Strength



Much of the steel can be saved in making nuts by cutting a groove across the top of each one about two-thirds the depth of the nut. The threads remaining on the uncut sides provide enough holding power and strength. A slight arch at the base of the nut adds a locking feature that causes the nut to bind under turning pressure.

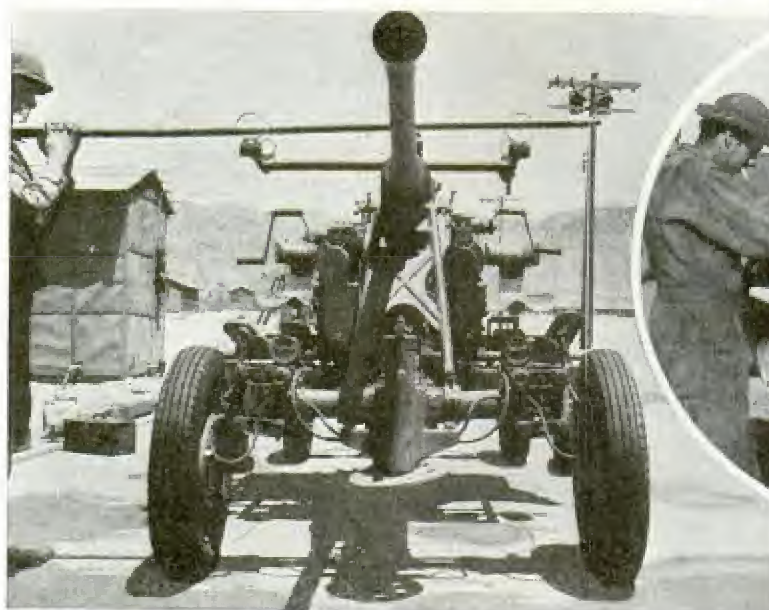
Look in the index to find where to buy articles described in this magazine. Say You Saw It in Popular Mechanics.

Mac-Lean - 7099 Lockport
26497 Kilar, Chicago

*Capt J. P. Lytle, 2205 7th Ave. N.E.,
Bakersfield, Calif.*

Tank and Gun "Doctors" Operate in the Field

2011183



For want of a horseshoe nail a rider and a battle were once lost, according to legend. Horseshoe nails aren't so important in keeping modern mechanized units of the U. S. Army rolling, but crack repair crews and parts for tanks, guns, trucks and even jeeps are vital today. Much of the repair work is done in the field with members of the crews keeping an alert eye and ear for enemy bombs or bullets. The men, above, are repairing a 250 horsepower radial engine in tank. Upper left, using special instrument on anti-aircraft gun to reveal wheel misalignment. Army mechanics at front line bases are noted for speed, ingenuity



U. S. Army Signal Corps photos

Above, field lubrication car being used to grease a tank at advanced base. Frequent servicing of tanks, specially on hot desert battlefields, is essential to keep these iron fortresses in top fighting condition to blast the enemy

"Hold it!" shouts mechanic on top of tank as crew working with repair truck lifts 1,300-pound motor for quick repair job. Other equipment for field crew includes new mobile electric arc welder used to "heal" battle scars



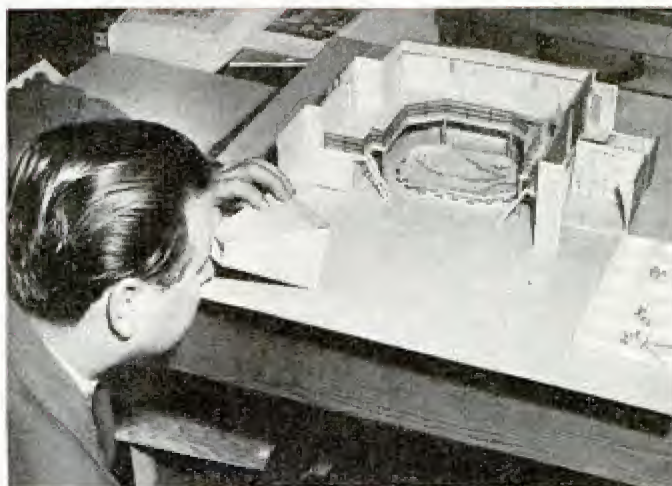


HOLLYWOOD is making most of its movies indoors this year. Daytime exteriors are apt to be spoiled by the noise of bombers and fighter planes on patrol, and big out-of-doors night scenes are prohibited by dim-out regulations.

Pictures can't be made at sea or even along the beaches and headlands. For security reasons, not even water reservoirs can be used to double for the ocean.

Under those circumstances, how would you like to be asked to stage a full-size ocean battle for the screen? R.K.O. was faced with that problem when it decided to film "The Navy Comes Through." The script called for the firing of a big 5-inch gun on the deck of a ship, for near-misses by bombs alongside the ship, and for a storm and fog at sea.

First, the studio built a 125-foot section of a full-sized ship inside one of its sound stages. The ship's deck is complete even to anti-aircraft machine gun turrets and the big 5-inch naval gun. The gun does everything except fire a real shell, yet its materials cost only \$20. The near-misses that landed



Inspecting scale model of plotting room for "Eagle Squadron." Below, filming action on deck of studio ship on sound stage





Jack Otterson, Universal Studios art director, left, using periscope to study camera angles on set model of "Forever Yours." Right, big steel water tank used for filming undersea scenes

alongside the ship were simulated for the screen by dumping 850 gallons of water down a 40-foot chute built like a ski slide, allowing the water to land right beside the set and deluge the gun deck. The same water chute contributed the big waves of the indoor ocean storm. Ocean fog was manufactured simply by spraying quantities of mineral oil against electric hot plates that vaporized the oil into fine mist.

To make sure that the antiaircraft machine guns would fire perfectly, the studio technicians fitted a spark plug inside each and valved acetylene gas into the gun barrel. Making and breaking the spark circuit exploded the acetylene gas in a realistic imitation of gunfire.

Another problem was to show bullets from a German plane ripping into the concrete gun shield. This was done, not with real bullets, but by drilling out each bullet hole ahead of time, inserting a dynamite squib in each hole, then plastering them over. Set off rapidly one at a time by electricity, the squibs gave the effect of bullets slamming into the concrete shield.

In a sea picture, of course, the ship must roll and the horizon must rise and fall. In this case both the ship and the horizon were stationary, but you wouldn't know it on the screen. The horizon shots were made by pointing the camera at big glass slides that moved up and down and on which the horizon line and clouds were painted. A

huge sun arc light, mounted on a rocker arm, provided the illusion that the ship was rolling. When the arc was swung back and forth, shadows of the ship's rigging moved back and forth on deck.

All motion pictures, of course, are illusions. Sets and backdrops are mere imitations of the real thing, usually, yet the art directors who design them use them in a subtle



Water cascading over gun inside sound stage is poured down tall chute, to give effect of heavy sea

Copyright R.K.O.



Copyright R.K.O.

Preparing to shoot a scene centered about the big naval gun on deck of ship "far at sea"—actually on studio sound stage. The five-inch gun which looks like real article cost only \$20

way to do much more than an audience realizes. Jack Otterson, art director at Universal, explains that scenery or a set can be used to help tell the story or to establish a mood which in turn will heighten the effect that the actors are creating. The art director may even distort or exaggerate the furnishings of a set to help establish the feeling of a picture.

Thus none of the settings in a *Frankenstein* picture are quite normal. They are deliberately designed to symbolize the weird and fantastic. On the other hand, in a picture of the "Boys From Syracuse" type, the art department plays around with conventional scen-

ery and treats it lightly to help provide the humorous touch. Sometimes a set, such as the office of an important man, is made larger than it actually is, just to convey the feeling of importance.

Getting a set ready for the actors and



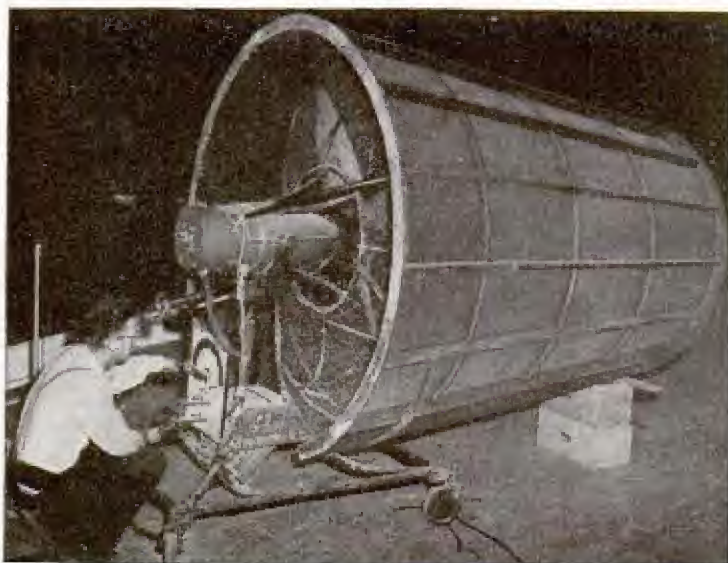
Machine gun on studio cruiser spits real fire made with spark plug and tank of acetylene gas
Copyright R.K.O.



Filming closeup of bomb explosion for "Wake Island," Paramount's cameramen work inside their specially designed bombproof booth



At "anchor" in Universal's back lot is this movie ship ready to buck the flood that will rush down water chutes at left. Below, adjusting the portable "windmaker" that produces South Sea hurricane or Chicago gale with its huge tunnel and airplane-type fan



cameraman begins at the time a picture script is decided upon. First the art director and the producer break the script down into scenes, then the art department prepares sketches to show the appearance of each scene. Scale models of large, ornate sets may be built so that camera angles may be studied.

These sketches and models then go to the drafting room where actual plans are drawn. The plans show only two or three walls, braced from behind. If a ceiling is to be shown in the picture it will be made of muslin. A "hard" ceiling would bounce too many echoes back to the microphone.

Next, prints of the plan of each set are sent to the construction department and to all the other departments that will help prepare the set. A print may go to the drapery department if window drapes are needed, another print goes to the set-dressing department that will provide all the properties, such as furniture and fixtures. The plumbing department gets a print if plumbing must be provided to create a rainstorm. Fire, wind and thunder are handled by special-effects groups.

The construction department rarely builds up a set from brand-new material. It has a storehouse full of different kinds of fireplaces, for instance, and long racks of full-sized "flats" that represent various interior and exterior walls. Several of these flats, with door and window openings in the right places, may be just the ones needed for a scene after they have been repainted.

In the new Deanna Durbin picture "Forever Yours," one set consists of materials that were used in 11 previous films.

(Continued to page 158)

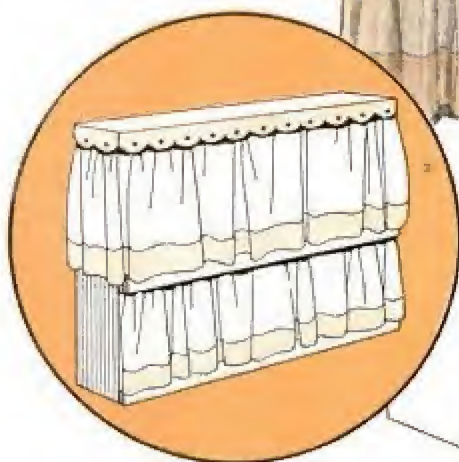


The CRAFTSMAN

Child's

WARDROBE

has space for toys



Portable "stowaway" to supplement closet-space shortage in compact living quarters. Orange crates provide pigeonhole compartments for toys below curtained wardrobe attached to wall

HERE'S a wardrobe that is of special value to families living in small apartments and rented homes, as it provides an inexpensive way to relieve crowded closet space and, being a knockdown affair, there's no problem at moving time. It can be improvised at practically no cost from a few orange crates, scrap lumber and some cloth. Whether as many as five crates can be used as shown in Fig. 1, depends, of course, on how large a wall space is available. Making the lower part is simply a matter of fastening the crates together, side by side, with strips across the top and bottom as

shown in Fig. 4, and then fitting draw curtains to the front. Note in Fig. 5 how the strip at the top is spaced with cleats to provide room for a strong cord or wire to be strung tautly between screw eyes for the curtains. Colored cardboard will do to cover the exposed ends of the crates, thus saving painting, or cloth can be used here to match the curtains.

The shelf board should be as wide as the orange-crate unit and cut a little longer than its length, so that the curtains will hang over the ends. Except where these are tacked in folds to cleats at each end of the shelf as in Fig. 2, they are hemmed to slide on a cord strung between the end brackets, after which a scalloped valance of matching or contrasting cloth is tacked to the edge of the shelf to add a finish.



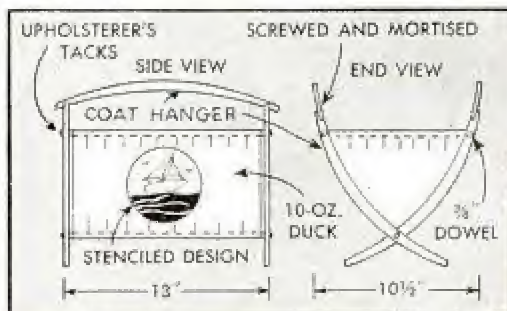
Screw eyes along the back edge of the shelf are spaced to permit screws to be driven through them and into wall studs as shown in Fig. 3. Additional support is provided by three wooden brackets which merely rest against the wall. Locating the studs is done by tapping the wall lightly with a hammer and noting where it sounds solid.

As the wall provides the back of the curtained enclosure, intervening wall studs within the space are used to support coat-hanger rods. Objection to marring the wall with these can be overcome by fastening wood strips vertically to the back edge of the shelf in which lengths of broomstick can be fitted in holes to project outward as hangers.

In rooms where there is insufficient wall space to permit using the wardrobe as shown, it could be made to fit waste corner space. Assembly would be quite similar, except of course, that the shelf board would have to be mitered at right angles over the center bracket and the orange crates assembled in an L-shaped unit to fit the corner.

Folding Legs Keep This Beach Bag Out of Sand

An excellent bag for carrying articles at the beach or while boating can be made from six wooden coat hangers, three dowels and about one yard of heavy cloth. The bag will fold flat and is large enough to hold several bathing suits, caps, a camera, sport glasses, etc. To make the bag, remove the wire hooks from the hangers and pivot four of them together in pairs with a single dowel to form the ends of the bag frame. The bottom dowel is held in place with two brass screws, one in each end, while the top two dowels, which help join the ends together, are fastened with upholsterer's tacks. Now, pin the cloth in place temporarily on the frame and mark the locations of the seams with a pencil. Then remove the cloth and

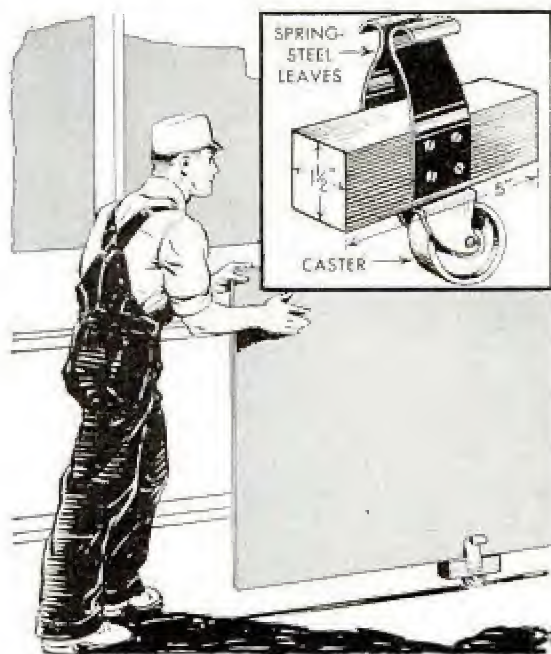


sew it to form the bag. Remove one of the frame ends from the dowels and slip the bag in place. Replace the end and mortise and screw the remaining two hangers into the upper ends of the end hangers to form handles.—G. E. Basich, San Diego, Calif.

Large Panels Are Moved Easily With Snap-on Caster Unit

One man can move large panels of wall-board, wood or other material by means of this simple caster unit, which snaps over the lower edge of the panel. The unit con-

sists of a hardwood block fitted with a caster and two pieces of flat spring, which are screwed to opposite sides of the block and bent to form a clip. In use, the unit is slipped over the lower edge of the panel near its center of balance, thus making it possible to push the panel along with ease.



Cleaner for Pipe Smokers

You can clean and sweeten your pipes with materials from the kitchen—baking soda and vinegar. Place a pinch or two of soda in the bowl of your pipe and, as you stand over the sink, pour a little vinegar over the soda and quickly cover the pipe bowl with your thumb. The mixture effervesces and cleans the pipe thoroughly as it works through the stem. Repeat the process as often as you think necessary and then let the pipes dry.

—John B. Mitchell, Peoria, Ill.

When making peppermints, drop them onto a piece of waxed paper and they will be easy to remove when cool.

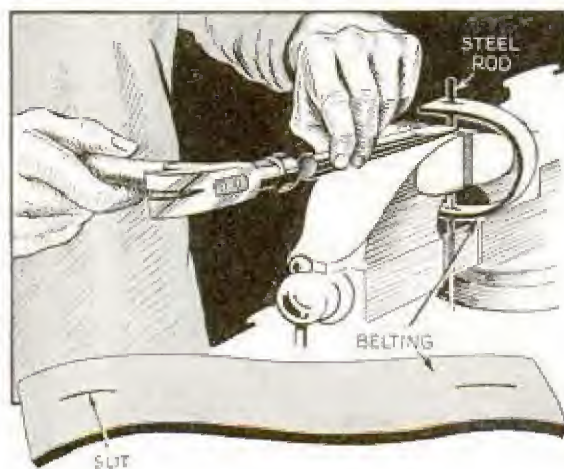
Channel Formed by Wood Strips Aids in Cutting Sheet Metal



If you have a heavy piece of sheet metal to cut and only a pair of light shears at hand, a channel formed by nailing two spaced wood strips to the floor or bench top will help. If one handle of the shears is placed in the channel, it will keep them from tipping when pressing down hard with one hand to operate the shears. Also, the channel will serve as a guide in cutting straight across the metal sheet.

Flying of Rod Pieces Prevented While Cutting Them Off

When a length of rod is gripped in a vise for cutting off short pieces with a cold chisel, you can keep them from flying about by using a short length of belting slit near



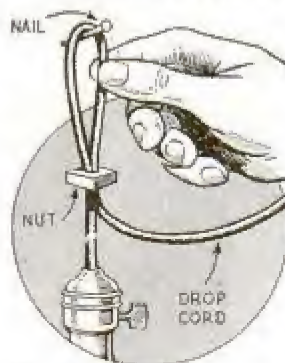
each end. The rod is run through one slit and then clamped in the vise as indicated, after which the other end of the belt is slipped over the end of the rod to be cut.

Metal Shield for Fishing Reel Made From a Tin Can

Due to the shortage of rubber, which makes it impossible to use sections of rubber hose as protectors for fishing reels, some sportsmen are using screw-top cans for this purpose. The can is slotted along one side to slip over the reel and the cap is screwed on to hold the assembly in place.



Drop Cord Kept From Slipping When Hooked Over Nail



The next time you can't prevent a drop cord from slipping when hooked over a nail to keep the light in a convenient position, try doubling a portion of the cord and slipping a large nut over it, as shown.

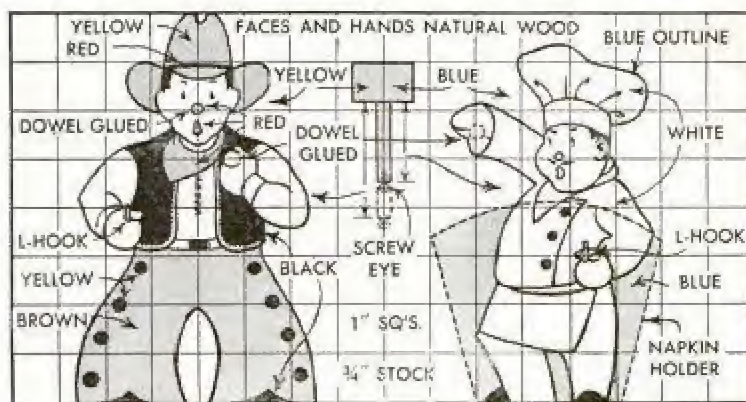
The loop thus formed is then hung over the nail or hook to hold the light.

Repairing Chipped Enamelware

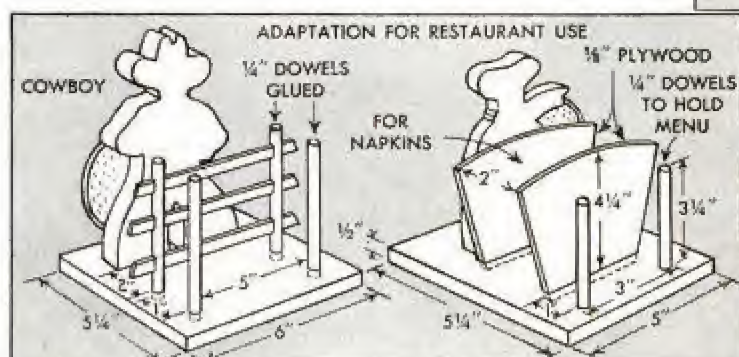
Once enamelware has become chipped, the metal underneath will rust rapidly unless it is protected. To do this, rub the metal with fine abrasive cloth until it is bright and clean. Then use a good flux and give the spot a good coating with solder. This gives added life to the ware and prevents rusting.—John Krill, Youngstown, Ohio.



Colorful Dinner Gongs and Napkin Holders



Standing pertly on round bases, with a mallet hanging from one hand and a dinner gong from the other, these gay little figures will add a touch of color to your table. If desired, they can be mounted on large, square bases and used in restaurants and tea rooms to hold napkins and menus as well as dinner gongs. Each figure is screwed to its base and has a short dowel in one hand on which to hang the gong and an L-hook in the other hand for the mallet,



which has a screw eye in the end of the handle. The gongs are tin-can lids hammered to a concave shape, and the mallets are small wooden blocks fitted with dowel handles. On the cowboy figure, a napkin holder is provided by placing a miniature rail fence 2 in. behind the figure, while the menu holder consists of two dowels set into the base 1 in. behind the fence. For the chef, the napkin holder is made by mortising and gluing two pieces of thin wood into the base behind the figure as indicated, using two dowels to hold menus.

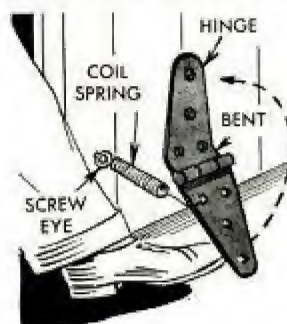
—R. L. Fairall, Los Angeles, Calif.

☛To prevent cats scratching in a garden, sprinkle ground orange peel over the dirt.



Handy Stop for Garage Doors

Bent and screwed to a garage door as shown, a large strap hinge makes an excellent doorstop that can be operated with your foot. The addition of a small coil spring provides tension on the lower half of the hinge so that it will "bite" into the ground when in use. Also, this serves to keep the stop in a raised position when the door is closed.



Solving HOME



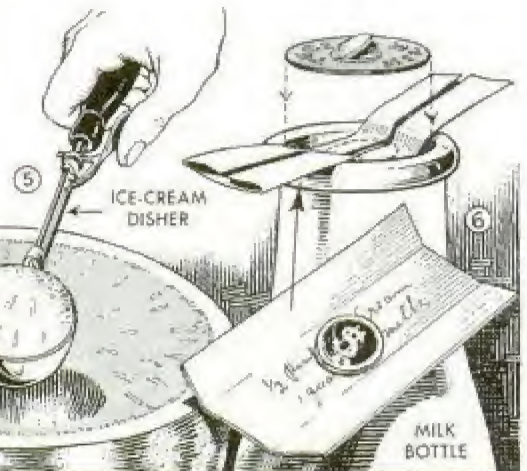
4—The annoyance of having her silk stockings dry with streaks in them led one housewife to hang them between damp towels. This caused the moisture to evaporate evenly so that streaks were avoided



1—Where coat hooks are so close to a door that garments get between it and the casing, drill two holes in the casing at an angle to take an umbrella rib, which provides a guard to prevent the trouble

2—Life of oilcloth shelf material is increased considerably by covering it with waxed paper, as this keeps dishes and bowls from sticking to the cloth and ruining the coating when they are removed

3—You can stop splashing of liquids from an electric mixer by slipping an oiled-silk or similar cover over the bowl. Of course, an opening with reinforced edges must be provided in the center for the beaters



5—When serving small portions of watermelon, an ordinary ice-cream dipper provides a quick means of dishing it out in the form of small, appetizing pieces. This is much more attractive than the usual large pieces which include the rind. 6—To avoid displaying coins in a bottle set out for the milkman, fold them up in your order so that the paper can be laid across the bottle mouth and anchored securely with the cap

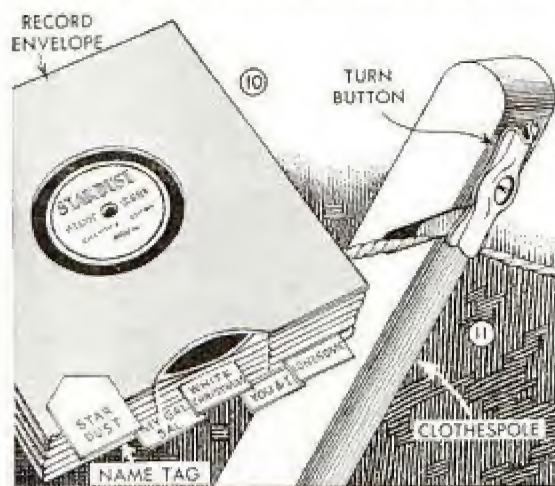
PROBLEMS



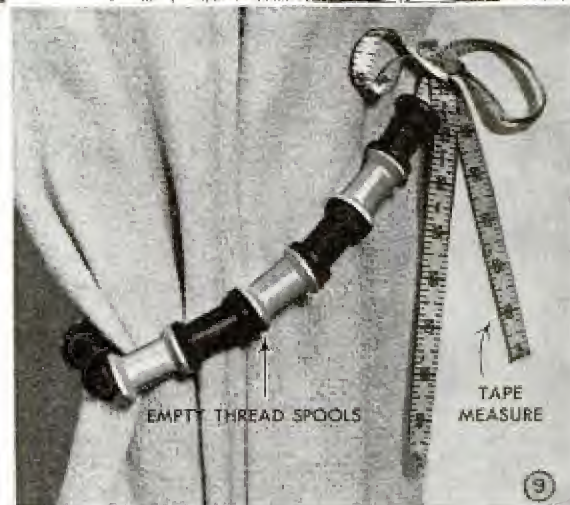
7—Small paper sacks are kept closed without tying them by rolling the top edges over pipe-stem cleaners and then bending the ends back. As the cleaners bend easily, they can be used many times

8—To prevent intruders from raising a window, a reliable stop is made quickly from a length of dowel, which is held in place by a pin or nail at the lower end while the top slides in a large screw eye

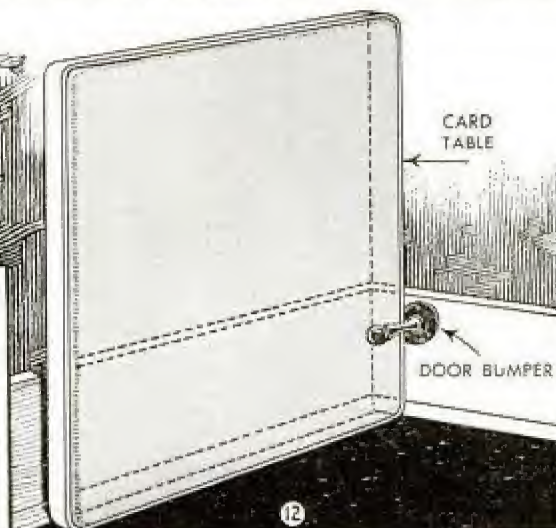
9—After being enameled in a variety of bright colors and strung on tape measures, empty thread spools lend themselves to additional usefulness in the sewing room by serving as tiebacks for drapes



10—It's a simple matter to locate phonograph records when they are kept in individual envelopes, if each envelope is fitted with a name tag as shown. Note that the tags are spaced so they can be read easily when stacked or placed vertically. 11—If you have trouble keeping a clothes pole in place on windy days, cut a notch at an angle near the top of the pole for the line and then attach a turn button just above the notch to serve as a lock



12—To store a foiled card table in a crowded closet so that it will occupy little space, screw a door bumper to the baseboard near a convenient corner and slip the table between the bumper and wall

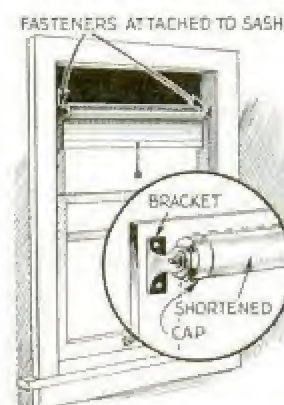


Oilcloth Envelope on Clip Board Stores Extra Papers



Shipping clerks and others who have use for a clip board will find that a large envelope or pocket made from oilcloth and fastened to the back of the board is handy for storing extra papers. This is especially true when invoices, bills, etc., are clipped to the board as they can be removed and slipped into the envelope as the items on them are checked off.

Window Shade Put on Top Sash To Prevent Damage by Wind



If you are in the habit of lowering the upper sash of a window to provide ventilation, mount the shade on the sash and it won't be damaged by the wind. To do this, you will have to put the shade brackets on the sash and shorten the roller to suit.

When shortening the roller, remove the cap and nail at one end, saw off the required length and then replace the cap. Be careful to saw straight so that the end of the roller will be square, otherwise the roller will not turn true between the brackets.

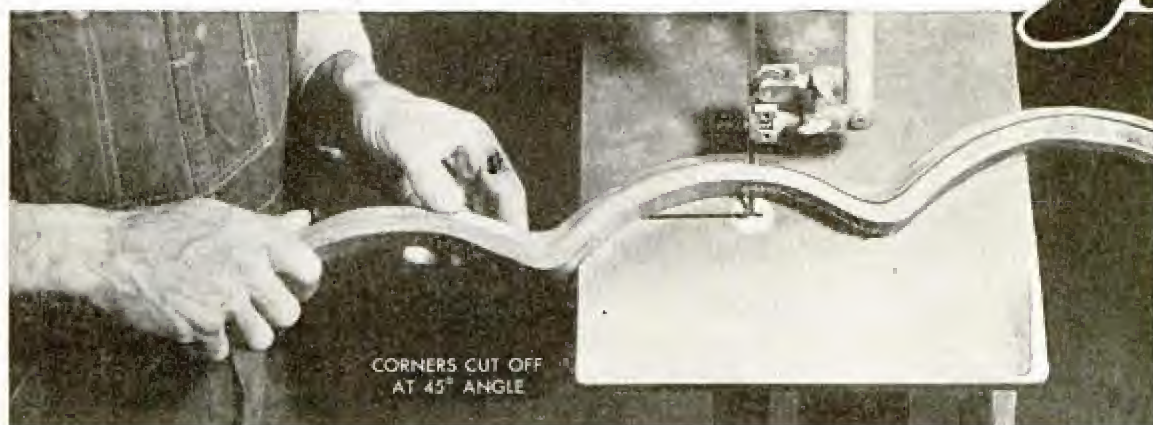
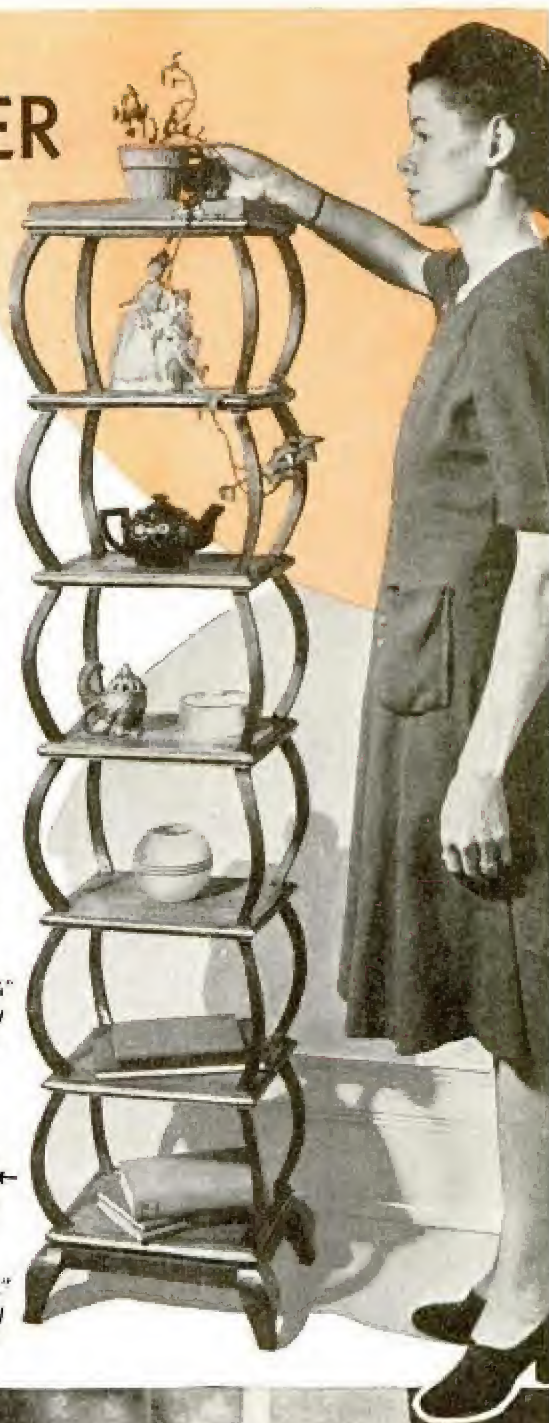
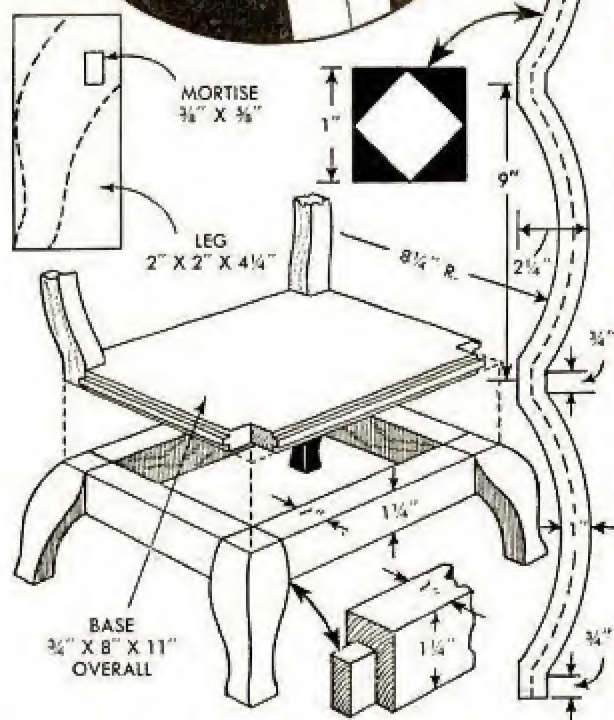
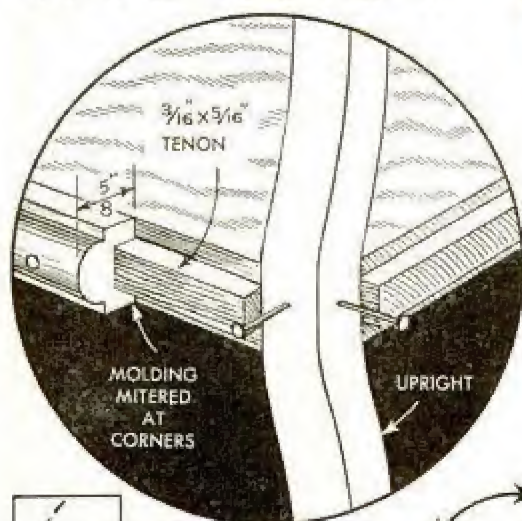
—Wm. L. Matthews, Kansas City, Mo.

How the Whatnot Tier Is Made

There's a corner in your living room waiting for this beautiful whatnot tier, which will show your favorite curios to excellent advantage. Needless to say, walnut, mahogany or cherry should be used for such a piece and finished with extra care. The manner in which it is put together assures exceptional sturdiness, as the slender uprights are not only glued and nailed securely in notches but are strengthened further by a molding on each shelf. All seven shelves are exactly alike, each having a tenon cut completely around it and a notch at each corner. The tenons can be cut on a saw if you do not have a shaper. In making the feet for the base, first draw a pattern, following the shape indicated by the dotted lines, and trace around it on one face of four 2 x 2 x 4¼-in. blocks. Before this is sawed, the mortises in adjacent faces for the rail tenons should be cut. After sawing, tack the waste pieces back onto the block and trace the pattern in a reversed position on the face adjacent to the one just cut. Make sure, before cutting the second profile, that the nails holding the waste pieces are not in the line of cut. Follow the above procedure in cutting each foot and then sand them smoothly. The length of the rails should be cut to bring the feet even with the outer edge of the tenoned shelf.

Economy in laying out the scalloped uprights will be had by nesting the pattern as closely as possible, leaving sufficient space to saw apart. Bandsaw them carefully to line, with the table at right angle to the blade, and afterward draw a center-line down all four edges of each member, as represented by the dotted line. These serve as guide lines in sawing away the corners with the table tilted 45 degrees, as shown in the photo at the bottom of the opposite page. By sawing a little to the right of the line and giving the blade plenty of time to make each cut, the sanding required to remove the saw marks will not reduce the size of the pieces appreciably. Complete the job by attaching the uprights to the shelves in the manner shown in the circular detail, and screw the base from below to the bottom shelf. If you like, a narrow scalloped railing can be added to the top shelf as shown in the photo. This is mitered at the corners and kept even with the shoulder of the molding.

Graceful WHATNOT TIER



Clamp Prevents Pinching of Saw When Cutting Plywood Panels



When cutting a large panel of plywood, the severed edges can be prevented from pinching the saw by using a large paper clamp. After you have sawed into the panel a sufficient distance, the clamp is slipped over the edge of the panel so that it grips the wood on both sides of the saw cut, as shown in the detail.

—G. E. Hendrickson, Argyle, Wis.

Colored Adhesive Strip in Shoe Aids Small Child in Dressing



As a help to small children when putting on shoes, a colored strip of adhesive tape is put inside the shoe for the right foot. As a child that is right handed usually will try to put a shoe on his right foot first, he is simply taught to put the marked shoe on first. The tape may be colored with ordinary crayon and should be placed in the shoe where the child can see it easily.

Basting Cloth Without Pins

Cellulose tape often can be used for basting and arranging cloth to be sewed on a machine. First, however, a test should be made to see that the cloth will not be damaged when the tape is removed. This

method saves considerable time and is better than pinning, as the pressure foot of the sewing machine will ride over the tape.

—A. L. Mills, Chicago.

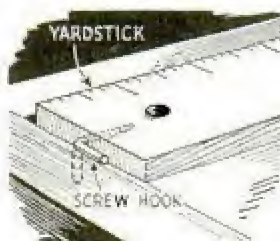
Sinker "Clamped" to Fishline

To attach a lead sinker to a fishline so that it can be held at any point on the line without using knots, one fisherman cuts the sinker half-



way through at the center so that it can be opened like a hinge. The line is passed through the sinker loops, drawn through the cut and the lead closed over it.

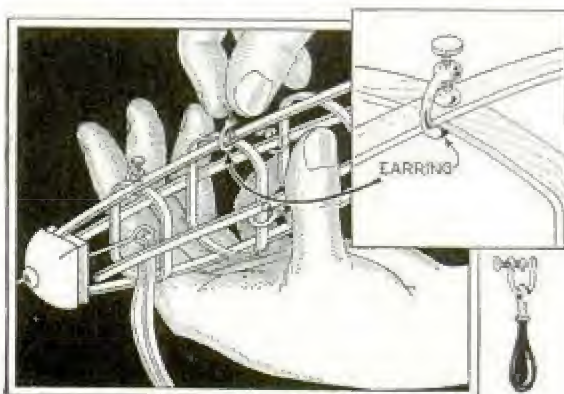
Screw Hook in End of Yardstick Assures Accurate Measuring



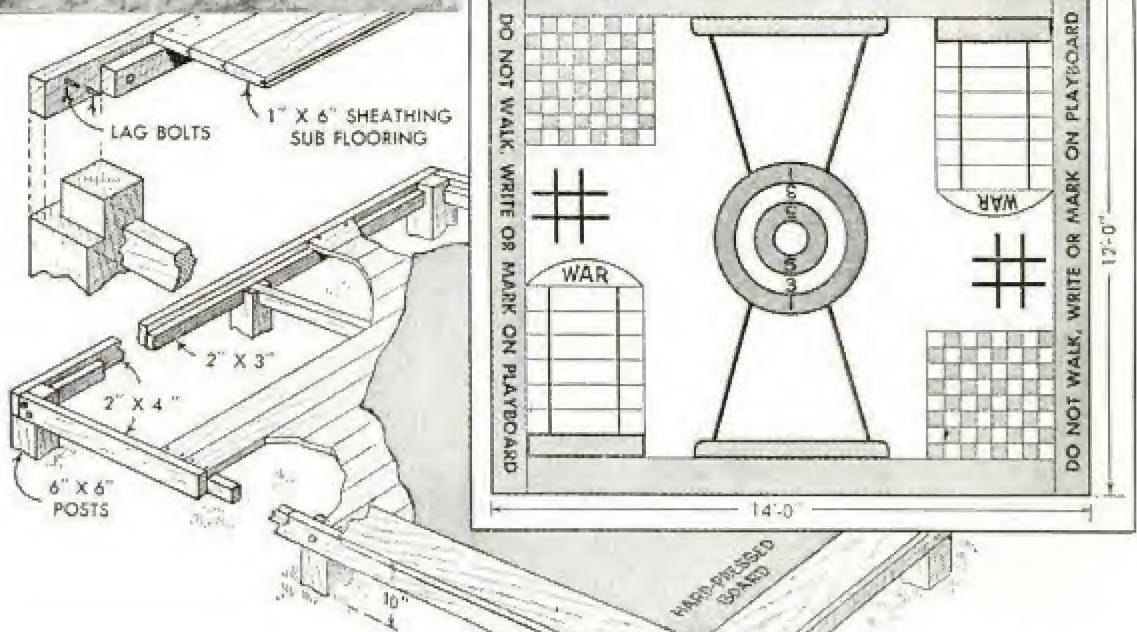
You can hold the end of a yardstick flush with the edge of boards for accurate measuring by driving a small screw hook into the end of it as shown. In this position, the hook can be turned parallel with the yardstick so it will be out of the way when not in use, or it can be removed entirely when taking inside measurements.

Small Clamps for Modelmakers From Inexpensive Earrings

When a light clamp is needed in gluing balsa strips, modelmakers will find ten-cent earrings suitable. They require no altering except to remove the ornaments.



Several Children Play on Multiple Game Board



Set up in a playground in Union, N. J., the outdoor game board shown in the photo has painted on it several games of the type children usually mark off with chalk and play on streets and sidewalks. As more than sixteen can play at one time, the board has served in keeping them off the streets in a safe place. Such a board can be made as shown in the detail. It is built on creosoted posts, and consists of a 2 by 4-in. framework supporting a subfloor of 1 by 6-in. sheathing, which is topped with a covering of hard-

pressed board. A border of 1 by 10-in. boards provides seats for the children while playing. All joints and abutting surfaces should be set in white lead to help keep out moisture. To avoid splinters, all wood that the children come in contact with should be sanded, and the entire assembly should be painted. The subfloor should be painted before applying the hard-pressed-board top.

—Edward Biertuempfel, Union, N. J.

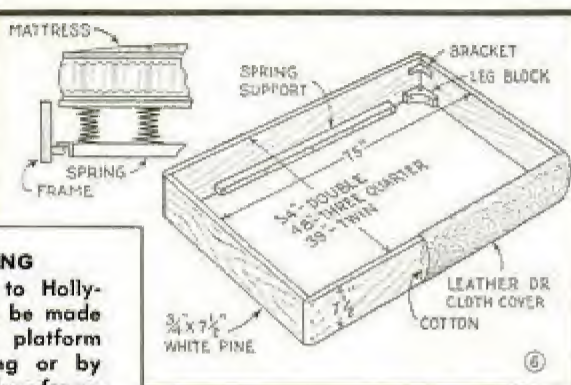


OLD BEDS *go* MODERN



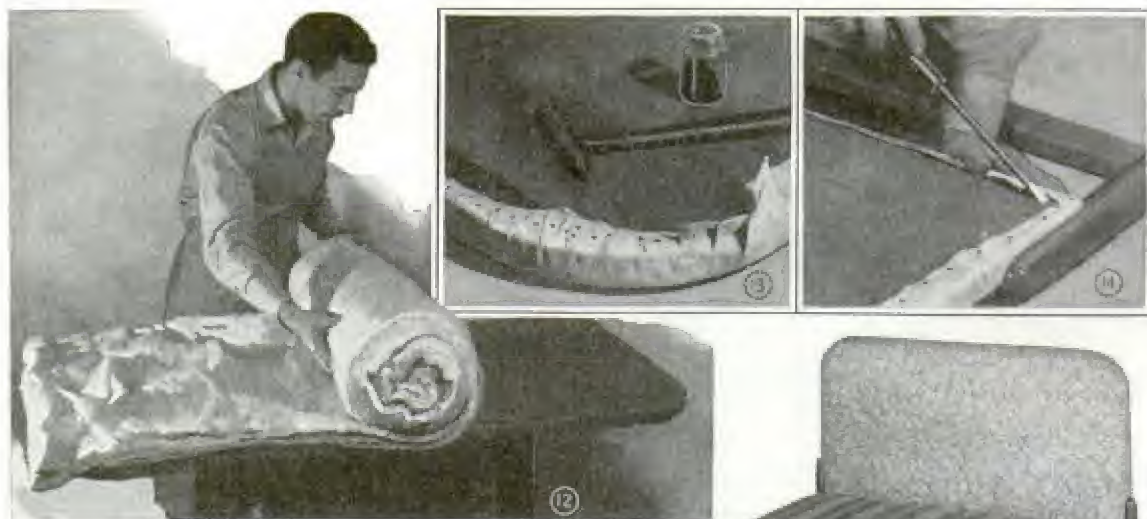
SMART "Hollywood" styling in beds that has become popular involves the use of a box spring and mattress set on four or six short legs. The usual footboard is eliminated. In most cases the headboard is quite simple, often being a separate piece of furniture, such as the compartment headboard style in Fig. 7, which houses a small radio, books and has cabinet space for other items. Beds of this style are easily made from older beds provided the spring and mattress are in good condition.

In making the conversion the first job is to box the spring. The conventional platform spring has an iron rail all around the bottom, and this serves as a mounting for a wooden framework, as detailed in Fig. 1. The exact method to be followed in mounting the framework depends on the spring construction. The more common method of working, applicable to almost any style of spring, is to use a hardwood frame, as shown in Fig. 2, which is fastened in place by means of pieces of angle iron or wood blocks. A $\frac{7}{8}$ -in. hole should be bored in each corner to take the legs and if six legs are to be used, holes should also be drilled midway on each long side. Then the spring is ready to be covered with 10-oz. cotton duck or other suitable material. This is tacked to the wood at the bottom as in Fig. 4 and it should be sewed all around the wire edge of the spring at the top, as shown in Fig. 3. Two layers of felted cotton are applied over the cloth foundation, and then the casing material is stripped in place and tacked all around as in Fig. 5. The cotton should be applied



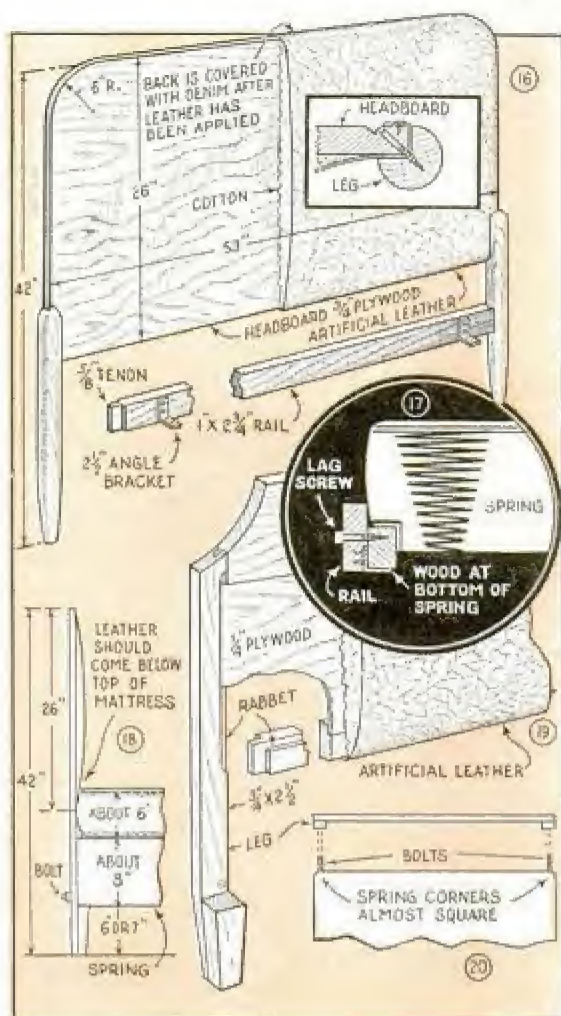
START WITH THE SPRING

Box spring essential to Hollywood bed styling can be made from conventional platform spring by upholstering or by using a simple wooden frame



COVERED HEADBOARDS

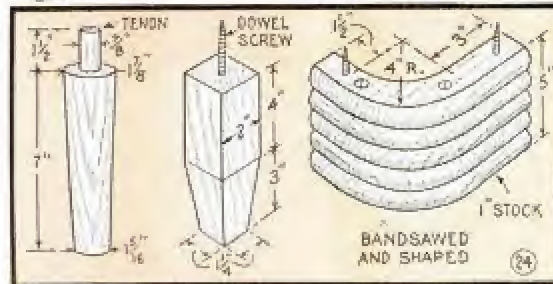
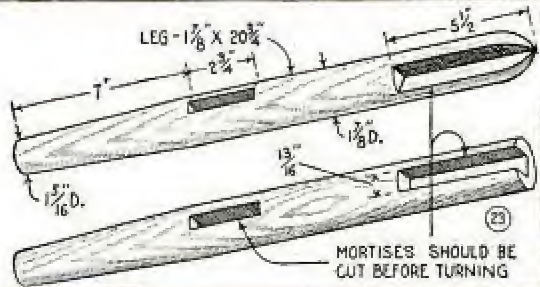
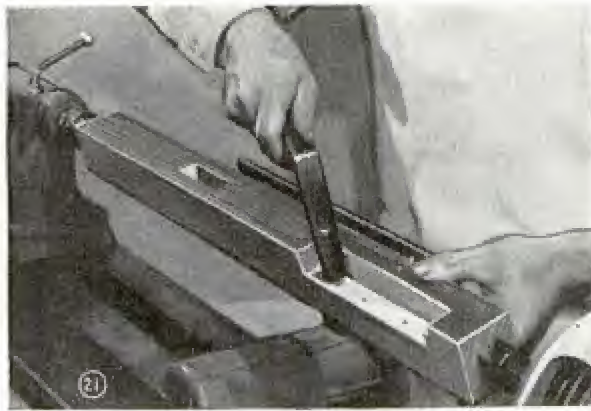
Artificial leather in white, blue or cream color over $\frac{3}{4}$ -in. plywood makes an attractive headboard. Cloth, quilted or buttoned, also is attractive and can be used to advantage for matched units of bedspread, headboard and bedroom drapes



ticking, obtainable in a number of different colors and patterns. Finally, the open bottom of the spring is covered with inexpensive black cambric as a dust seal. Upholstering can be eliminated entirely by boxing the spring with wood, as shown in Fig. 6, but the wood can be covered with felted cotton and imitation leather or cloth if desired. The bed is completed by fitting four or six short legs in holes provided in the framework, although, if the framework is wide enough, the legs may be omitted.

Compartment headboards are good functional design and easy to make. Fig. 8 gives the details of the one shown in Fig. 7. It is made from $\frac{3}{4}$ by 10-in. white pine with glued and nailed joints and a lacquer finish. The bed is pushed up against the headboard to complete the ensemble. Other ideas for compartment headboards are shown in Figs. 9, 10 and 11.

Leather- or cloth-covered headboards are attractive, and often the lumber in the old headboard can be utilized. The work is quite simple—a slab of wood, then a layer of cotton, Fig. 12, and finally a cloth or leather cover. If the top of the headboard is rounded, the corners can be turned with minimum wrinkling by cutting the leather



into tabs, as shown in Fig. 13. If the headboard has a panel set in a framework, it may be necessary to remove the framework to permit covering the panel, after which the framework is again fitted in place. Widening of grooves and rabbets may be necessary. In Fig. 14 the legs and cross rail had to be removed temporarily. Almost all headboards supply legs at the head, while the foot (and center if desired) is fitted with stub legs as before. Fig. 15 shows the box spring attached to a leather-covered headboard. Fig. 16 gives the essential dimensions and construction for this bed. Angle brackets at the cross rail provide support for the spring, but rigidity is obtained by means of the lag screws fitting through the rail and into the spring framework as shown in Fig. 17. The legs are detailed in Fig. 23. A similar style but in built-up construction is shown in Fig. 19. The leg style shown here also provides a land for the spring, which should be made with almost square corners at the head end, Fig. 20, to fit properly. Fig. 18 gives



LEG STYLES

Stub legs should be 6 to 7 in. long to provide a mattress height of approximately 20 in. They may be round, square or built up from bandsawed pieces

general dimensions for this type of bed.

Stub legs may be round or square with a slight taper at the bottom, as shown in Fig. 24. The simplest method of mounting is to use a drive-fit tenon. If you have taps and screw boxes for cutting threads in wood, it is worth while to thread the tenons so that the legs can be removed. A less sturdy but quite satisfactory type of screw-on leg can be made by fitting the leg with a 2 1/2-in. No. 10 dowel screw. The shaped type of leg shown in the right detail of Fig. 24 is very attractive. The sections are first bandsawed, then shaped and screwed together. Screws countersunk from the underside fasten the leg to the bed frame.

Two styles of round headboard legs are shown in Fig. 23. The top turning has a quarter section cut out to take the headboard, while the bottom design is grooved to take the headboard. In making turned legs with cutouts of this kind, the mortises should be cut while the work is in-the-square. In turning the pre-cut work, it is necessary to protect the leading edge of the cut by tacking a strip of wood in place as shown in Fig. 21. In turning a pair of legs, Fig. 22, calipers are used to check diameters so the legs will be duplicate turnings.

Wheelbarrow Serves as a Dolly In Moving Small Boat



For moving a boat a short distance to and from a beach, one sportsman attaches rings to the gunwales of the boat to slip over the handles of a garden wheelbarrow. With this arrangement, the inverted boat can be lifted at the stern end and wheeled easily.

Wire Makes Portable Sprinkler From Your Lawn Hose



It is a simple matter to convert your lawn hose into a portable sprinkler by bending a piece of heavy wire to support the hose in a vertical position as shown. The loop and hook bends in the wire

hold the hose so that it may be moved easily to different locations on the lawn.

Individual Markers When Several Persons Read the Same Book

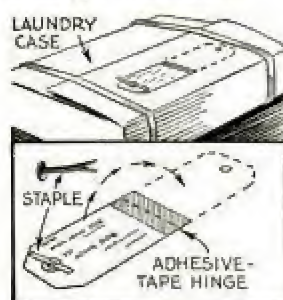
Members of our family often read the same book over a given time and sometimes experience trouble because one or two of the book markers become dislodged. To avoid this, we now use three cards of different colors. A lip is cut in each card

so that it fits over a page of the book to keep it in place. On the edge projecting from the book, the person's name is printed as an aid in instant identification.

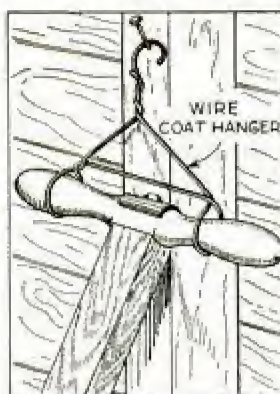
—W. F. Messenger, Ballston Spa, N. Y.

Hinged Tag on Laundry Case Reverses to Change Address

A reversible label to facilitate mailing a laundry case can be made by hinging an ordinary shipping tag to the case with a piece of adhesive tape as shown. In this position, the tag can be swung from right to left to show the desired address. Holes through the case take a stationery staple which holds the tag in the desired position.



Coat Hanger Holds Lawnmower Against Wall in Garage



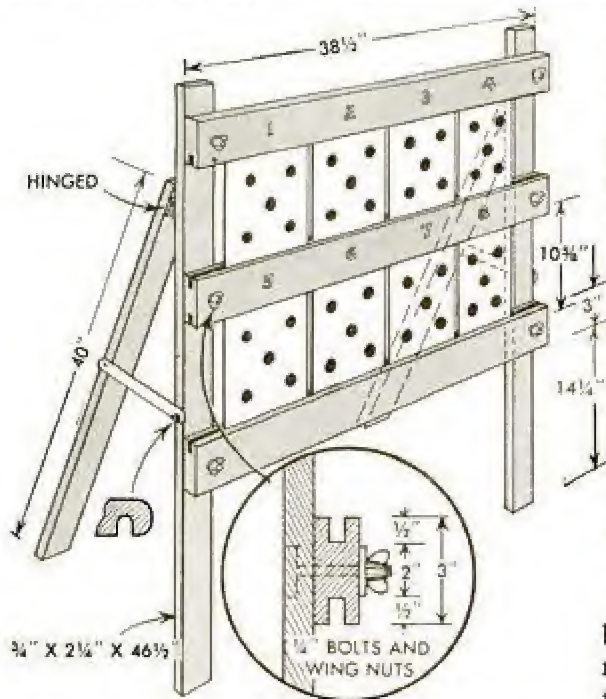
To keep your lawnmower from rolling when stored against a wall, twist the ends of a wire coat hanger and bend the resulting loops down. These are then slipped over the mower handle and the hanger is hooked on a nail.

Test Tubes Cleaned Thoroughly With Shoe-Polish Dauber

The problem of cleaning the inside surfaces of test tubes was solved by one chemist who used a shoe-polish dauber. It is just about the right size for most tubes and, when charged with a suitable cleaning material, will enable you quickly to remove stains and residue from the glass.



Rifle Target Bundled Easily to Fit in Car Trunk



Ideally suited to anyone who wants an outdoor target frame, this one can be dismantled and bundled to store away or put into a car trunk. The frame consists of three crosspieces and two vertical mem-



bers fastened together with bolts and wing nuts and supported by a hinged brace. The targets slide between the crosspieces in grooves and are backed by heavy cardboard to stiffen them. A dull black finish on the frame prevents light reflection and helps to make the targets stand out clearly.

—W. C. Thayer, Sr., Latrobe, Pa.

Simple Hand Transit Made From Carpenter's Metal Level

By sawing an inexpensive metal level in half and pivoting the two parts together at one end with a machine screw, you can make a transit with which to determine the heights of objects, such as chimneys, flagpoles, etc., where extreme accuracy is not important. To use the transit, stand a known distance from the object and hold the lower arm of the transit a known distance above the ground. Sight along the top arm to the point, the height of which is to be determined, keeping the lower arm in a horizontal position by means of the level. Then trace the two sides of the instrument on paper and complete the lines of a right triangle as indicated. Knowing the lengths of the horizontal and vertical lines of the triangle and also the distance from the object, you compute the unknown height, adding to this the height of the transit from the ground. The horizontal and vertical lines of the triangle are proportional to the horizontal distance to the object and its height, respectively.

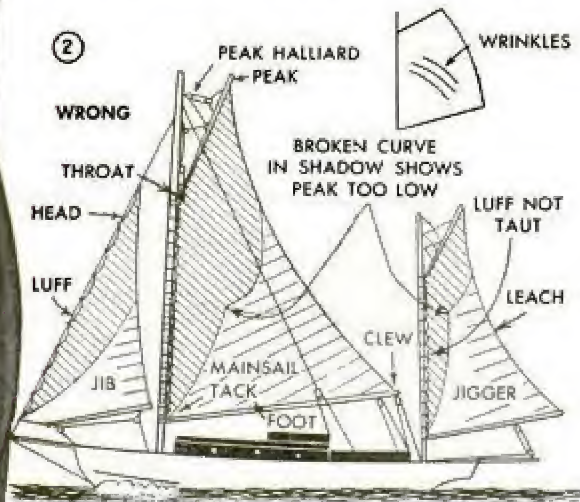
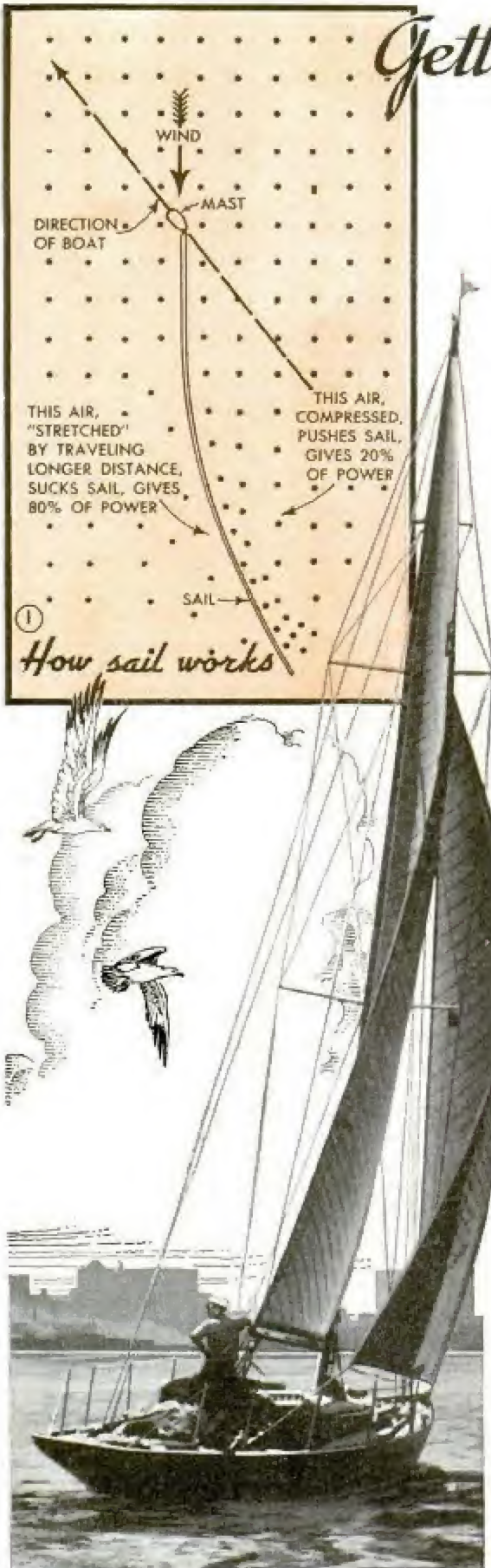


Getting the most from

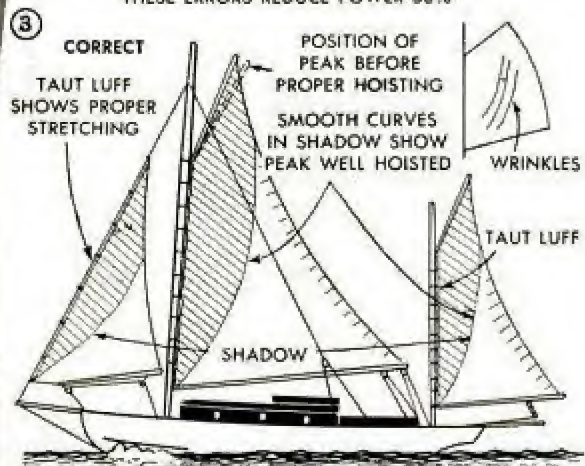
By Thomas P. Lake

Important shortcuts that good sailors use automatically and the novice should master. Tells all about location of pivoting point, fullness of sails, trimming, and how the helm is a clue to sail balance

THERE are many shortcuts in getting the most from your boat, whether it is a 10-ft. dinghy, a 40-ft. racing sloop or a 50-ft. heavy cruising type. First in importance is the fullness of a sail, for if it is either as flat as a board or as full as a sack of flour, best results in sailing cannot be obtained. A sail gains power by causing the air to flow past it in smooth lines; air



THESE ERRORS REDUCE POWER 50%



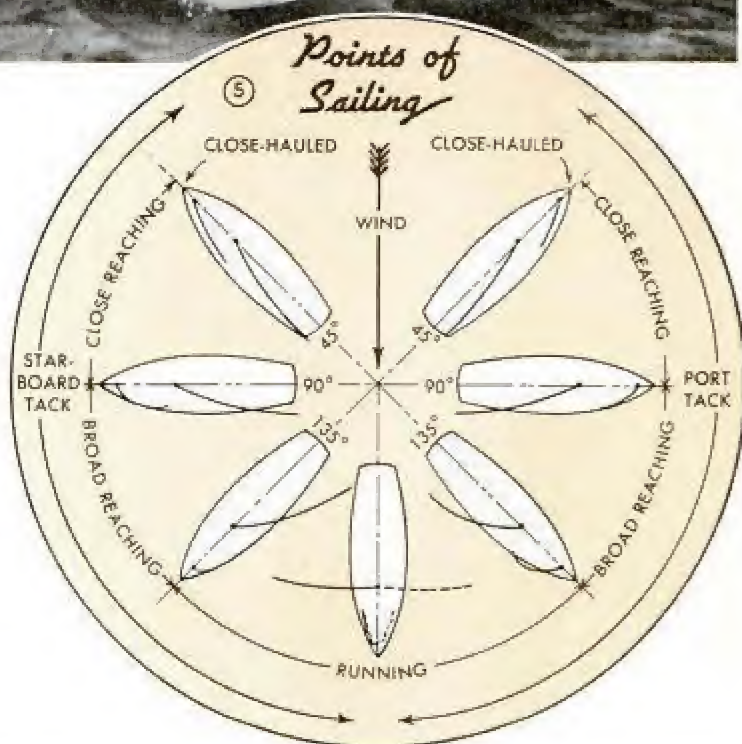
OBSERVE THESE POINTS TO GAIN FULL POWER

YOUR BOAT



on the leeward side (side away from the wind) travels a greater distance than that on the weather side (side toward the wind), as illustrated in Fig. 1. The leeward air is "stretched out" when it passes along the sail, and is at a lower-than-atmospheric pressure. The sail, in trying to move into this low-pressure area, transmits its pull to the boat. The air on the weather side is slightly compressed and adds its small effort to the total effect. The weather side supplies about twenty percent of the total, while the leeward side supplies about eighty percent.

Although the fullness of a sail is cut and sewed into it by a sailmaker, the sail must be set properly if it is to take its correct shape. This is especially true of a gaff-headed sail (sail with the gaff or spar at the head or top portion of sail). The shadow of the mast on a sail provides a good clue to how well a sail is hoisted. Fig. 2 shows a small cruising yawl with poorly hoisted gaff-headed sails. The broken curves indicate hard spots (taut areas), which break the smooth flow of air across

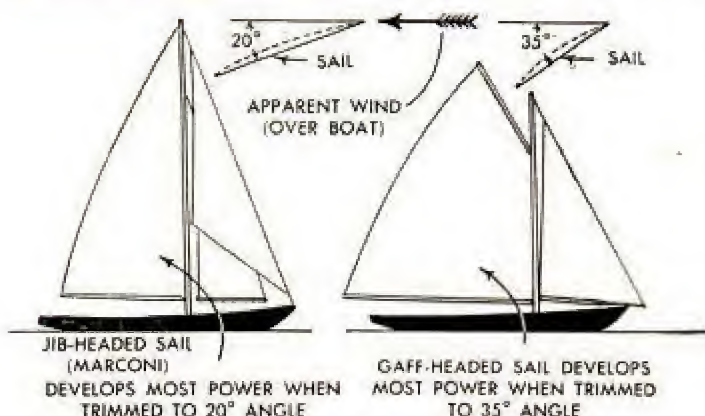
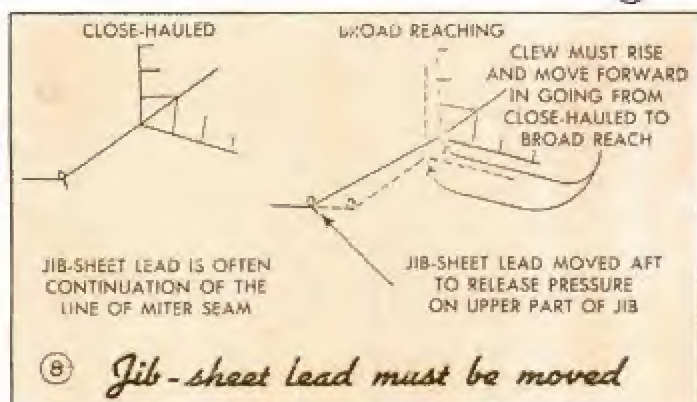


the sail, both windward and leeward as well. Such hard spots tend to cause little eddy currents that prevent the proper air flow over the sail and reduce its power. The smooth curves shown in Fig. 3 are the sign of well hoisted sails. Jibs (triangular sail forward of the foremast) and marconi mainsails (without a gaff) must be set properly also, and the shadows will help in determining this. Avoid hoisting a sail or stretching its foot (lower edge) any more



than just enough to make it set smoothly, free from wrinkles.

Fig. 5 gives the correct terms for the points of sailing. A close-hauled boat is sailing as close to the wind as is possible with advantage. When she is not as close to the wind as possible, even though only a few degrees from it, she is said to be close-reaching. When the wind frees (moves aft as seen from the boat), the reach changes from close to broad, and when the wind comes over the quarter (45 degrees

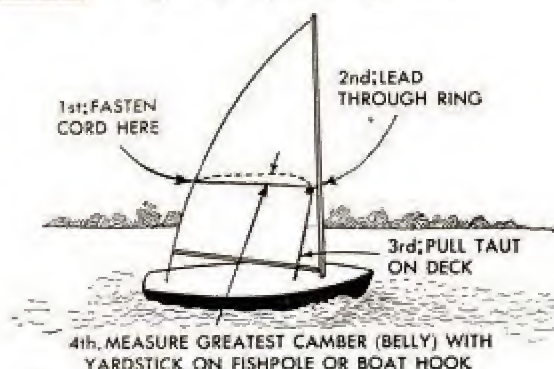


CAMBER — 1 FT TO 20 OR MORE
FLAT SAIL BEST IN HEAVY WIND

CAMBER — 1 FT IN 10 OR LESS. HAS GREAT
DRIVE, AND MUCH DRAG
FULL SAIL BEST FOR RUNNING AND
BROAD REACHING

CAMBER — 1 FT IN 15. HAS GREAT DRIVE
AND LITTLE DRAG
MODERATELY FULL SAIL BEST FOR BEATING
AND GENERAL USE

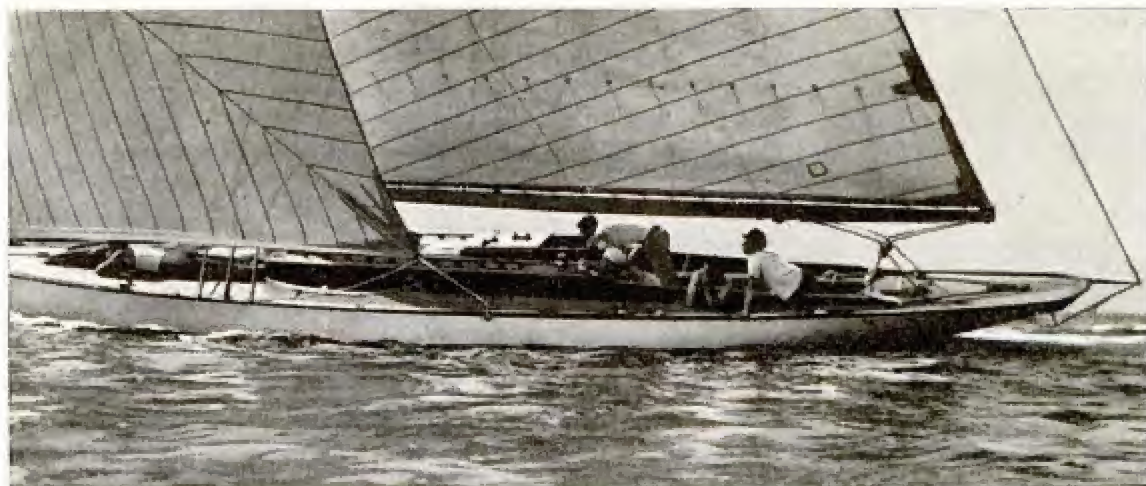
⑥ *Judging sail fullness*



⑦ *Measuring sail fullness*

from astern), or from astern (over the stern), the boat is said to be running (going with the wind).

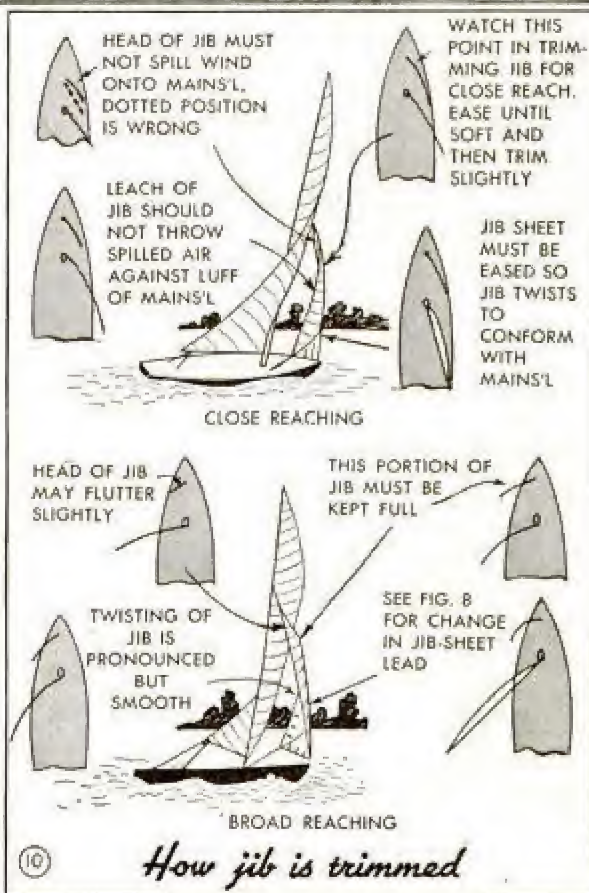
While there is wide difference of opinion concerning the fullness of sails, most American sailors seem to prefer a curve in a horizontal direction, with a depth of about 1 ft. in 15 ft., as indicated in Fig. 6. This curve is the camber of the sail. The fullness of a mainsail can be measured as shown in Fig. 7. If a mainsail is too flat, it can be given more camber by easing the outhaul (line to haul the corners of a sail to the end of a boom or gaff) and distributing slack of a few inches throughout the length of the foot. This is especially valuable when broad-reaching or running, and the results are well worth the trouble if such a course is to be held for even a short time. A flat mainsail is good for heavy weather because it is not efficient; there



is then a surplus of wind and high efficiency is not desired. A flat sail may require less luffing (slight shaking while spilling wind out of sail) to enable the boat to stand up to the wind. A gaff-headed mainsail requires different trimming than a marconi mainsail as explained in Fig. 9. The angles given are for apparent wind (the angle made by the wind over the moving boat); not for the true wind.

The draft (air flow) of a jib can be altered by shifting the jib-sheet lead in combination with trimming the sheet. The effect of moving the lead is shown in Fig. 8. When close-hauled as in Fig. 4, the lead should be in its forward position in order to distribute more strain to the upper portions of the jib and to make it set somewhat flatter. When reaching, however, the mainsail twists much more than it does when sailing close-hauled, and the jib must be allowed to twist to match it. If the lead is not changed, the jib backwinds the mainsail (blows against its leeward side) unless the jib is eased off (sheet slacked) until the lower portion is not pulling properly. To obtain the twist without slacking away too much on the sheet, the lead is moved aft 2 or 3 in. on small boats and up to 2 or 3 ft. on larger ones. Fig. 10 shows how the jib must be matched to the angle of the mainsail at various heights above the deck for close-reaching and broad-reaching. Accuracy in following these directions will help to increase the speed of your boat.

Probably the least understood factor in good sailing is the location of the pivoting point or center of gravity, which should be about under the center of buoyancy. In loading a boat, serious changes may occur.



The center of gravity may be moved forward or aft by such things as installing a larger motor than was intended in the design of the boat, the addition of a larger water tank, the placing of food stores, the stowage of luggage or spare sails, etc. Fig. 12 shows the effects of correct and incorrect ballasting. The top details show what happens when there is too much weight at the stern, the center details show effects when ballast is too far forward, and the lower details show results with a correctly balanced boat. You can determine the pivot-

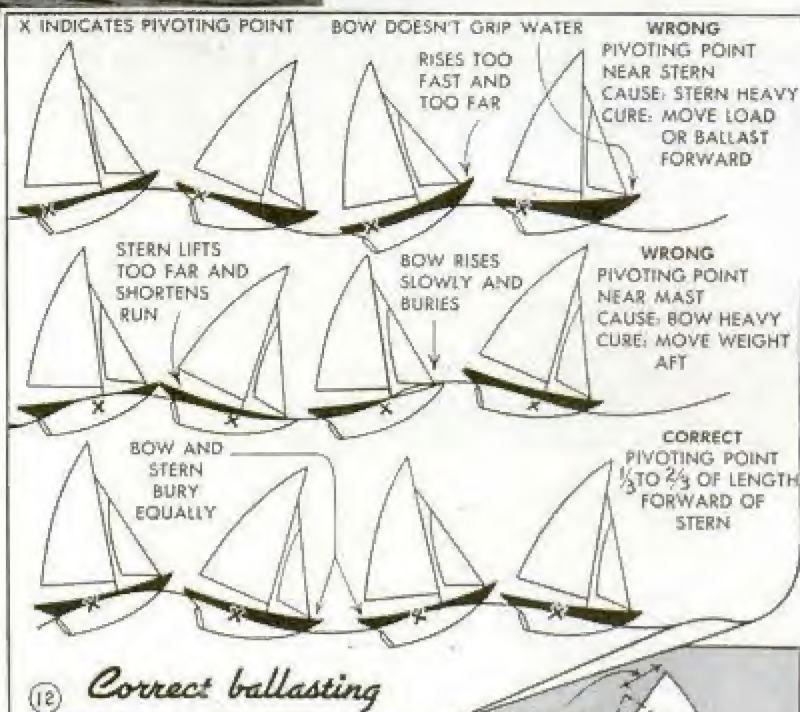


ing point by looking across the deck and moving forward and aft until the point about which the boat seems to pitch is located. It is usually best to determine the pivoting point of a boat in a somewhat choppy sea. If the pivoting point is about one-third the length forward from the stern, the ballast is approximately correct. Fig. 13 shows the effects of various pivoting points on a small boat. Also, with proper weight distribution disturbing sail motion is reduced.

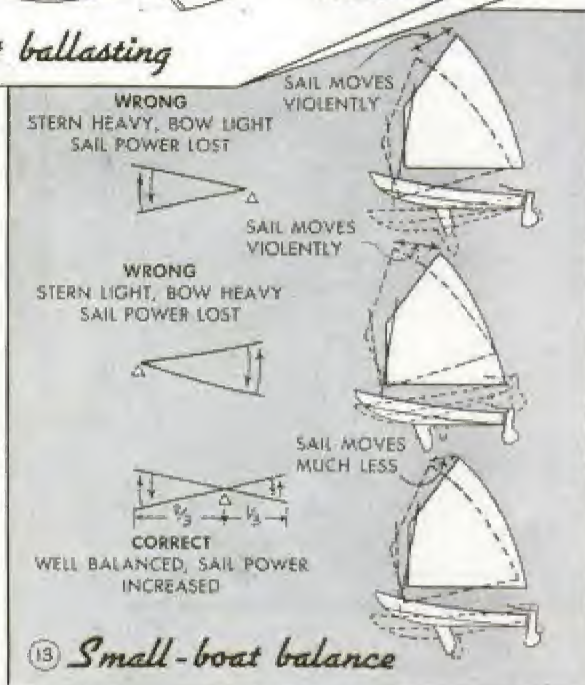
In the photo, Fig. 11, you can see a comparatively large bow wave. This large wave exists only on the lee bow, for the weather bow wave is much smaller. Fig. 15 shows how the bow shape of most boats produces a larger bow wave on the lee than on the weather side. The lee bow wave becomes in effect a large roll of water which tends to force the bow to turn into the wind and this wave becomes more pronounced as the angle of heel is increased. For this reason a squall, which heels a boat considerably, can be expected to create a very heavy weather helm quickly. Unless the thrust of the lee bow wave is met with an equal thrust at the stern, (from the rudder), the boat will turn to weather. Under such conditions however, the mainsail

can be eased off slightly until only the jib is closely trimmed. The jib may be considered as being too weak to balance the mainsail, and the latter must be eased as the jib is actually well trimmed and working. Otherwise, the entire balancing force must come from the rudder, which comes into play when the tiller is held to the weather side.

There are times however, when a slight amount of weather helm is of great advantage. Fig. 16



Correct ballasting











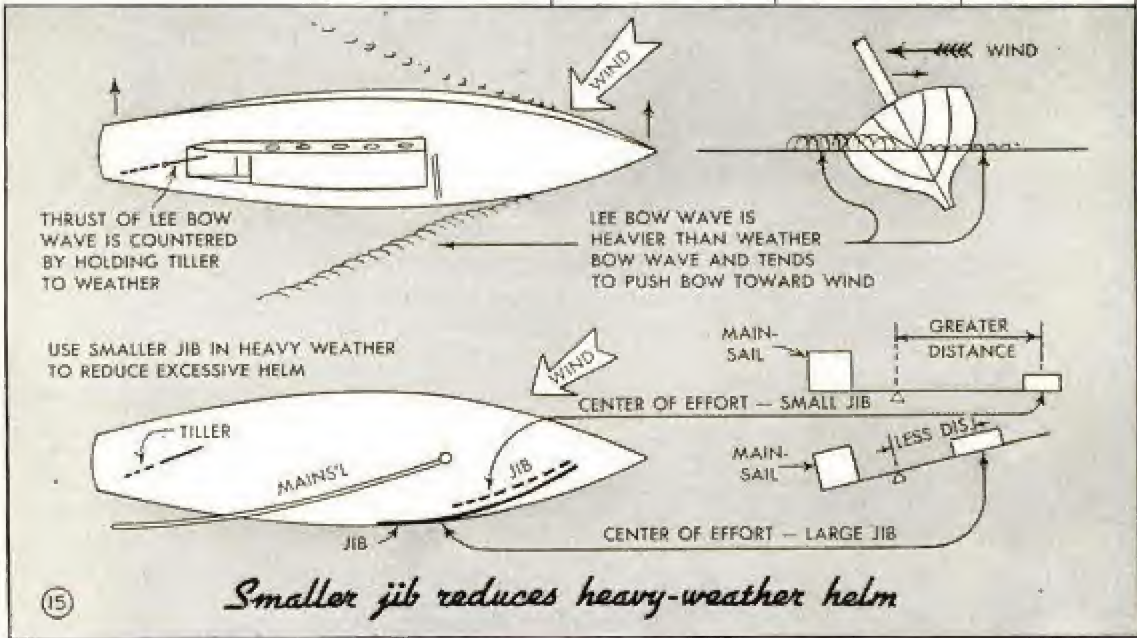
Small-boat balance

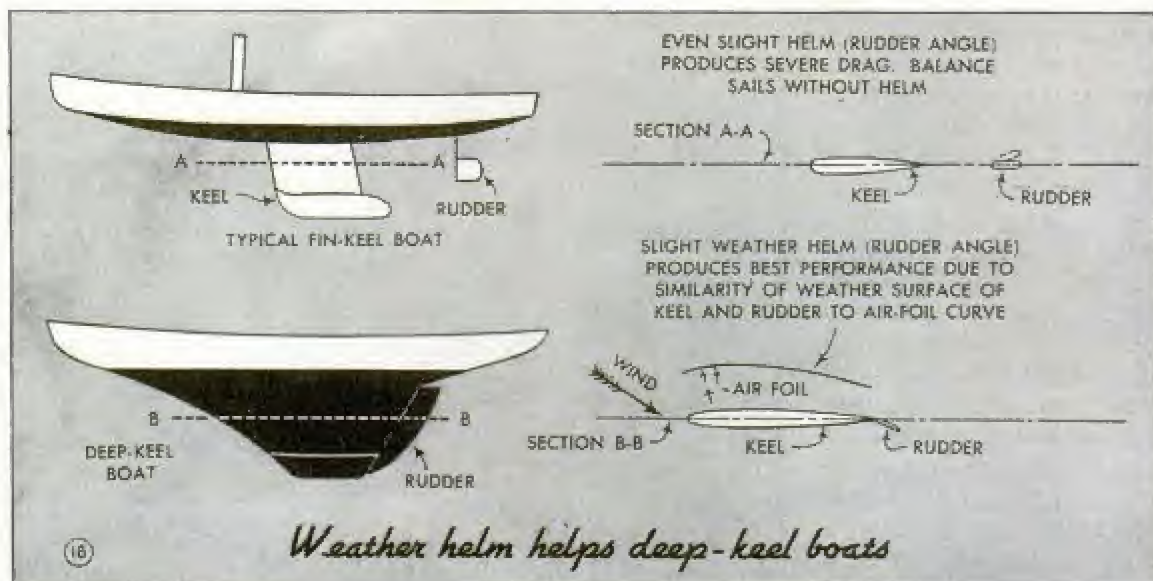
shows two common types of sailboat hulls—the fin keel and the deep keel. The fin keel should have its sails balanced very accurately because even a slight helm is a serious drag. The deep keel, on the other hand, becomes more effective than it is when the boat is sailing close-hauled with a slight weather helm. This is due to the fact that the keel and rudder are continuous and streamlined in a single unit, which forms a curve similar to the air-foil curve of an airplane wing, or of a sail. This curve is formed on the weather side of the keel-and-rudder assembly, (with slight weather helm), and makes it act somewhat like a wing or sail. The result is that there is a distinct tendency to draw the boat to windward. It becomes especially noticeable in the marked reduction of the leeway (sideslip), which is normally experienced when sailing close-hauled. With a deep-keel boat, you can determine the most advantageous position for the tiller when the boat is out of the water by laying a straightedge along the rudder and the after portion of the keel or false keel, and forcing the rudder over until a straight line is formed. Then carefully



⑭ *Watch helm for balance*

FAULT	RESULT	CURE
 JIB LUFFS	 HEAVY WEATHER HELM	TRIM JIB
 MAINS'L LUFFS	 LEE HELM	TRIM MAINS'L
 MAINS'L TOO FLAT	 WEATHER HELM	EASE MAINS'L
 JIB TOO FLAT	 LEE HELM	EASE JIB





note the angle made by the tiller, and trim the sails when close-hauled or close-reaching so that this angle will hold the boat on a straight course. When this is done, a marked improvement in performance will

be observed. The helm is the clue to sail balance when reaching as well as when sailing close-hauled. Fig. 14 shows the four conditions of poor sail balance disclosed by pronounced weather or lee helm.

Drill Press Operated With Crank When Used for Tapping

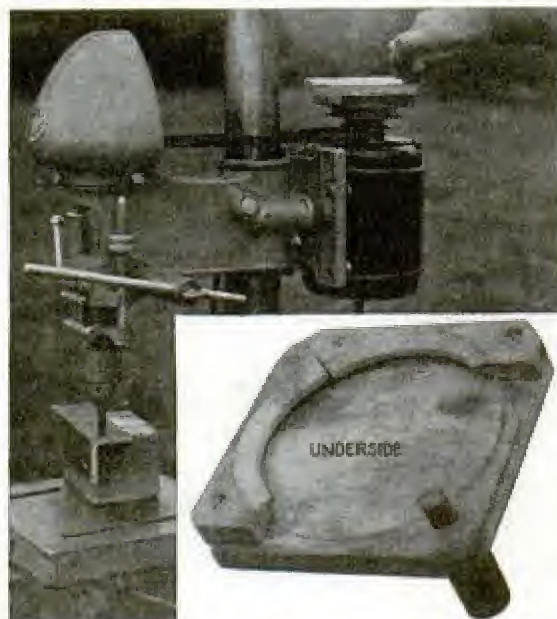
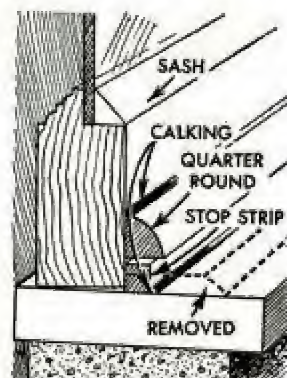
Instead of pulling on the belt to rotate a power drill press when using it as an emergency tapping machine, use a crank like the one shown and the job will be faster and easier. The crank is made from a square block of wood, which fits over the top of the motor pulley. Strips are screwed to the underside of the block and shaped as shown to provide a groove to take one half the edge of the pulley. A tapered dowel

serves as a hand grip and also bears against the opposite edge of the pulley to hold the crank in place. Friction between the pulley and crank is sufficient to prevent it from slipping.

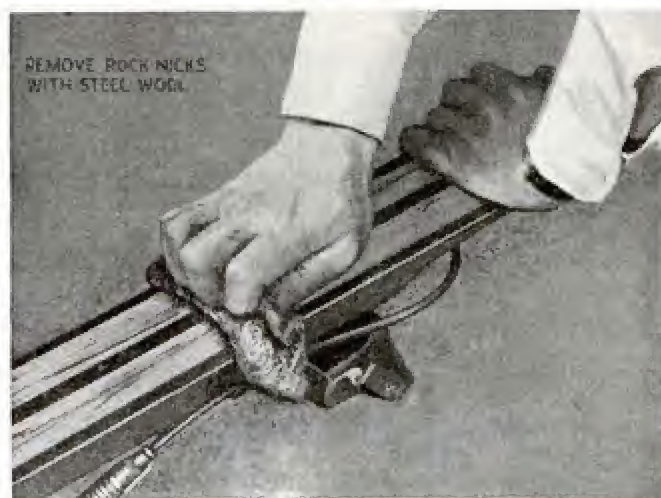
—E. R. Augustin, Jr., Livingston, Mont.

Drip Mold Prevents Seepage Under Basement Sash

Water seeping under basement sash during driving rains often causes considerable damage. This is true particularly where the sash are above the grade line. One simple way to avoid this trouble is to cut a length of window-stop strip to a snug fit in the frame and nail it to the sill. Then, above this, nail a length of quarter round to the bottom rail of the sash, allowing $\frac{1}{8}$ -in. clearance between the two parts so that the sash will close easily. Run calking compound in the corners as indicated.



How to Prepare Your Skis for Summer Storage



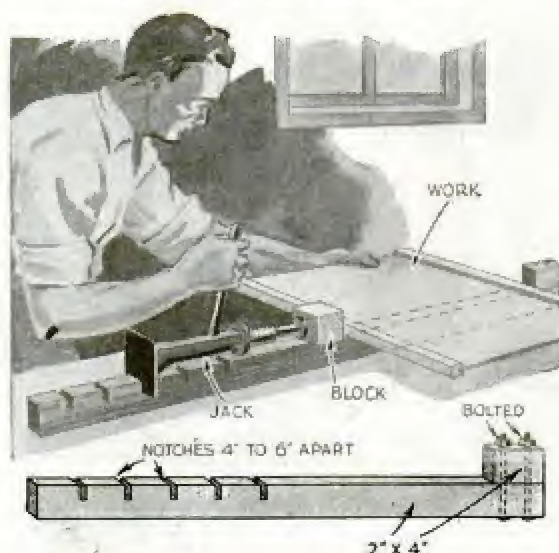
Skis should not be kept in a place that is too dry or too damp, or where they are exposed to sunlight. Usually a dark, well ventilated closet is the best place to keep them,—never in a humid basement or in a hot, dry attic. They must be protected against the absorption of moisture, and each one should be clamped separately in a suitable form to retain the correct shape. Before storing them, remove all wax or varnish from the top and bottom surfaces, and also the edges, down to the bare wood and carefully polish off any nicks with fine steel wool. When sanding the bottoms, use a sandpaper block, taking care to retain the smooth surface; always work with the grain of the wood from the tips to the heels. After the skis have been cleaned and sanded, remove all dust with a clean cloth dipped in carbon tetrachloride. Then apply two coats of waterproof varnish (marine varnish is preferable) to the top surfaces, and two or more coats of transparent lacquer to the bottom surfaces and to the edges, allowing each coat to dry thoroughly before applying the next one. Before using them next season apply two additional coats to the bottoms. If you use a pine-tar base wax instead of lacquer, linseed oil makes a good summer coating



for the ski bottoms. After coating all metal parts with thin oil to prevent rust, you are ready to clamp the skis in a form. The one shown can be made from well-seasoned 2 by 4-in. stock about 18 in. longer than the skis. Cut a groove in a dowel to hold the tips, making the groove the exact width of the tips. Drill the clamp for the dowel and nail it in position. At the opposite end of the form, make a slot for a carriage bolt, which holds the heel blocks. The shovel, or front curve of the skis can be held by a strap. A wooden block 1/2 in. thick should be placed under the balance point of each ski to give it the proper curve.

—Payson R. Gould, Milwaukee, Wis.

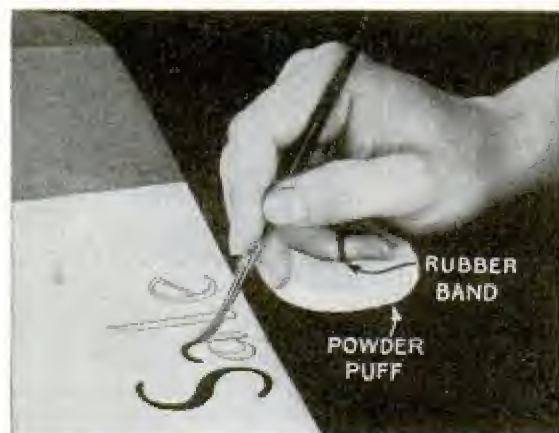
Woodworker's Powerful Clamp Made From Auto Jack



The next time you need a strong clamp with a wide jaw span and none is available, one can be made up to utilize your auto jack. Select a suitable length of 2 by 4-in. hardwood stock and bolt a block to one end to serve as one of the clamp jaws. Then cut several notches near the other end to take the base of the jack when it is laid on top of the stock as shown. It is likely that you will have to use a hardwood block at the end of the jack screw as the second jaw of the clamp. In use, just place the work between the two jaws and screw up the jack, using the notches to get the desired adjustment.

Powder Puff on Writer's Finger Provides Hand Rest

To avoid soiling show cards and to simplify the movement of his hand over them, one artist employs a small powder puff. A

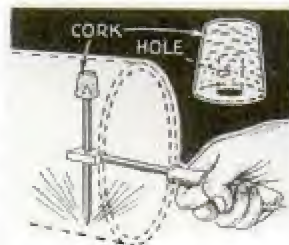


rubber band is stitched through the cover of the pad at the center, so that it will serve as a ring to hold the pad on his finger.

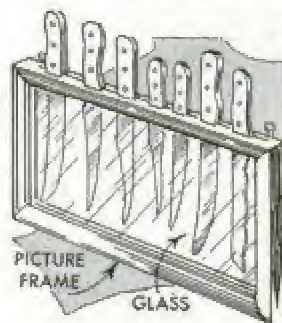
Carbon of Small Welder Shielded To Braze Inside Seams

Recently while brazing some inside seams on cylindrical containers that had diameters only slightly greater than the length of the torch carbon, I found that the upper end of the carbon often made accidental contact with the cylinders. To avoid this, I drilled a cork part way through and put it on the carbon, thus insulating it against accidental contact.

—W. C. Wilhite, Carlinville, Ill.



Picture Frame Serves as Holder For Kitchen Knives



If you need a holder for kitchen knives, a handy one can be made from an old picture frame in a few minutes. Slots to accommodate the blades are formed in the top frame member by cutting notches along the back and then covering the entire back with a thin piece of plywood. Screw eyes can be used to hang the holder on the wall.

cutting notches along the back and then covering the entire back with a thin piece of plywood. Screw eyes can be used to hang the holder on the wall.

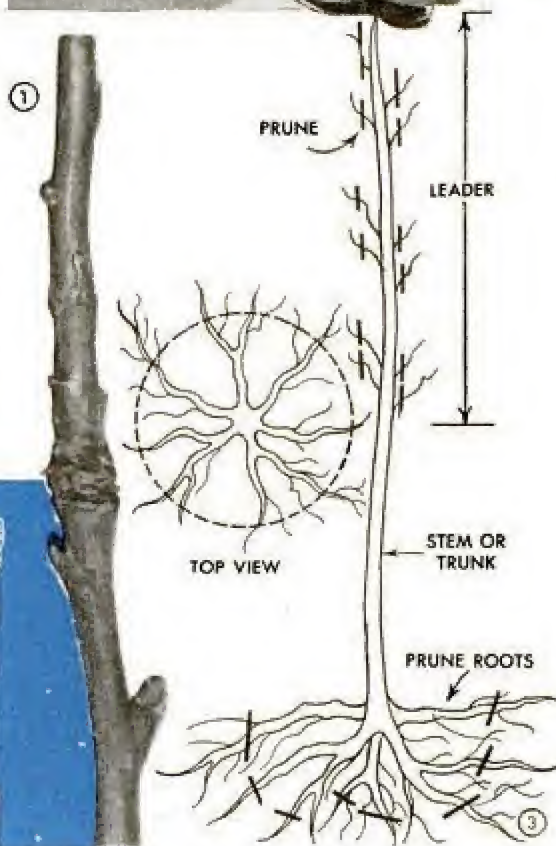
Helpful Suggestions on Painting Sound-Absorbing Material

When it is necessary to paint sound absorbing material, the porous surface must be covered without sealing it. Before painting, vacuum-clean the surface if possible. A solution of mild soap and water may be used on enameled material. The paint must be mixed carefully, used sparingly and applied uniformly. Soft paste white lead and a little more than an equal portion of thinner provides a good mixture. This thin mixture will not cover as well as paint intended for ordinary work. Therefore, three or more coats may be required.

When, Where and How TO PRUNE

INCORRECT pruning—or none at all—of young trees and shrubs often is one of the foremost causes of disappointing results when they mature. Future strength, shape and production of flowers or fruits of shade and fruit trees, particularly apple trees, and treelike shrubs are a matter of proper pruning at planting time and correct seasonal prunings for a few years thereafter. You must visualize the tree not as it is today, but as it will be several years hence. The immediate problem after planting is to shape a strong head (the juncture of the main branches to the trunk) and a compact frame (the main branches and their secondary branches).

When planting a one-year-old tree, reduce the root growth if too long, to balance the top growth after it has been shortened to spurs or stubs having one bud each, from which new growth starts. See Fig. 3. Select spurs in groups of fours, each group being 8 to 10 in. apart. If the tree is a "whip," that is, one having no side growth, rub off the unwanted long buds and cut through those that lie close with a sharp knife. When pruning, the location of the cut in relation to the buds is very important. In Fig. 2, the first sketch at the left shows an unpruned branch. The terminal bud is at the tip with cluster buds at the base of the tip; those farther down are axillary buds, which sometimes are found in pairs. The second sketch shows a cut made





mainly of forming the head, Figs. 4, 5 and 6. Fig. 4 shows a mistake often made by pruning which causes the entire weight of the tree to be borne at one point on the trunk instead of being distributed uniformly as in Fig. 6. The head should have from three to five main branches (usually three for an apple tree). Prune so that the buds or spurs are spaced around the trunk and up its sides as in Figs. 5 and 6, cutting the selected branches back from eight to ten buds. During the third year, or the second year if two-year trees were planted, complete the frame as in Fig. 7, treating each main branch as if it were an individual tree, except that the buds on it are not spaced around the branch, but should lie fanwise and parallel to the ground as much as possible. Take care to avoid weak crotches. Remember that growing strength is concentrated in the terminal, cluster and adjacent buds. Fig. 8 shows how growth is likely to develop if not cut back. Cutting back forces the weaker buds below the cut



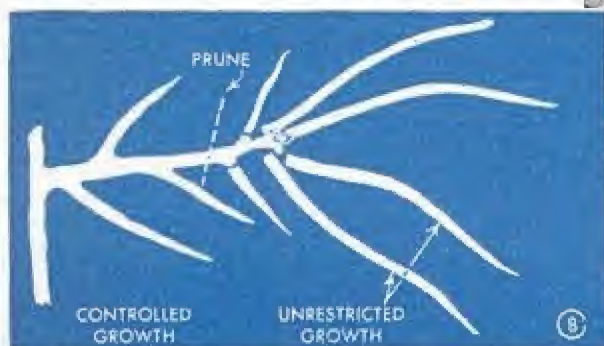
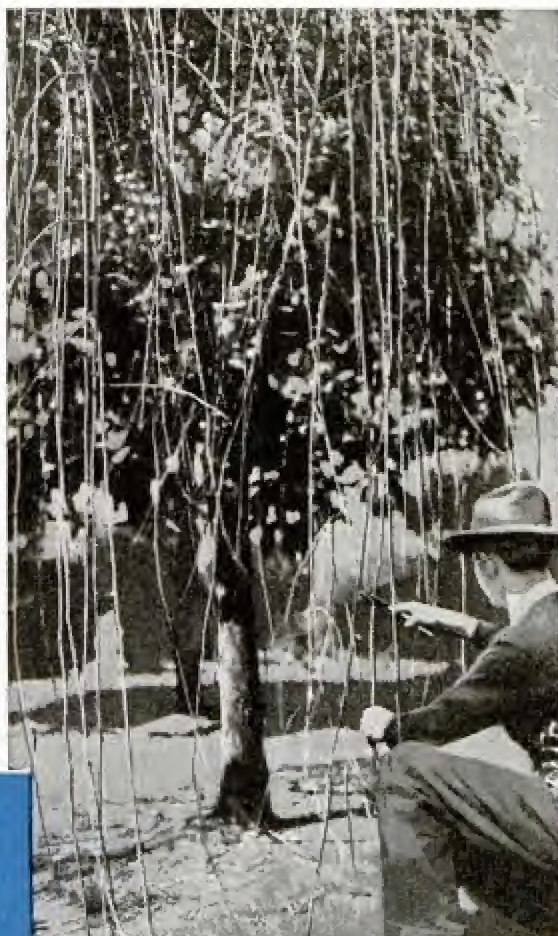
too long and slanting, causing the wound to dry too slowly, while the third sketch shows a cut so far above the bud that the stub is likely to rot. In the fourth sketch the cut is too close to the bud, which will dry and drop off. The correct way is given in the fifth sketch where the cut is slightly slanting and is about $\frac{1}{4}$ in. above the bud.

When the leader is taken, that is, when the unwanted vertical portion of the stem is removed, vertical growth of the trunk practically ceases. In commercial orchards the head is kept low, so that the lowest branch is about 2 ft. from the ground. On the home grounds you may want more height, however, and therefore the leader can be left until the second year. If a newly planted tree or shrub has developed two leaders, remove one, Fig. 10. On a tree that is two years old, whether it is being planted or is already set out, pruning consists

to grow and form a closely knit frame. As strong shoots start from the buds nearest the cut, you can control the direction of growth by cutting just above the buds pointing in the desired direction. Later pruning keeps the tree in shape, which requires cutting back about one third of the previous season's growth as indicated by a swelling of the branches where the new wood joins the old, see Fig. 1. When viewed in spring, the growth from the tip of a branch back to the first swelling is last season's wood.

Fruit trees should be pruned more thinly than shade and ornamental trees as an open center is necessary to admit light and air, which are essential to health of the tree and the color of its fruit. However, don't overdo this, for, as the tree develops, the weight will tend to move away from the center. Also do not remove short, stub-

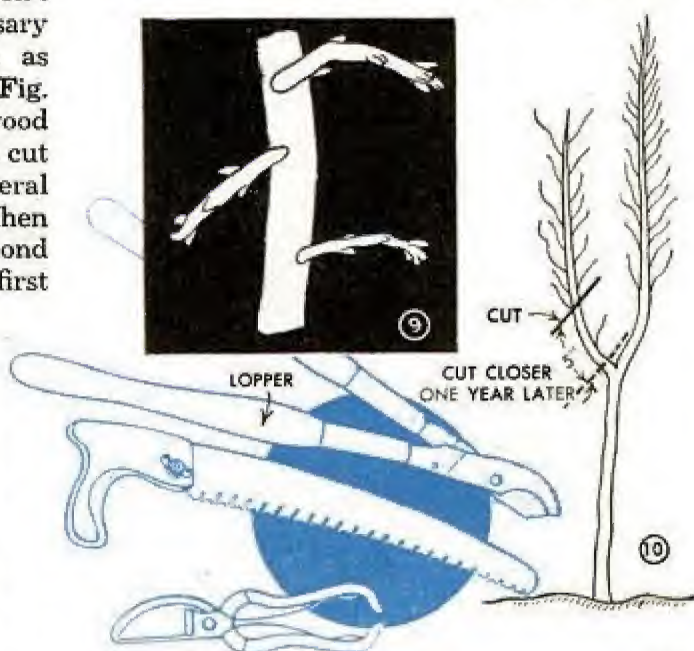
by twigs that may develop on branches, as in Fig. 9, as they will bear fruit for many years. Different kinds of fruit trees require different pruning methods. A peach tree should have four main branches spaced a little closer and nearer the ground than an apple tree, which usually has only three. If a peach tree is not pruned, it produces fruit on year-old shoots growing from terminal and nearby buds. These grow fast and long, and can be cut back at least fifty percent. Rampant seasonal growth can be cut back during the summer. After the frame of a pear tree has formed, prune lightly and toward outside buds when possible as pear trees are inclined to vertical growth. New growth starting from the trunk and low down on the main branches should be removed. The cherry tree, like all fast growers, is rather weak. A good head and frame are essential. Later severe pruning is unnecessary as fruiting is little affected. Pruning when growth is dormant or just beginning in early spring is advis-



should be cut. Those that grow from heads should be framed as apple trees, but with four or five main branches, giving due consideration to height of the lower branches. For sidewalk plantings, you will want extreme

able for the trees mentioned. Don't prune in winter. When it is necessary to remove large limbs, proceed as shown in Fig. 11; not as shown in Fig. 12, which results in splitting off wood toward the trunk. Always start a cut from the underside of the limb several inches from the trunk or head. When the saw begins to bind, make a second cut on top about an inch from the first one as in Fig. 13. After the limb drops, cut as close to the trunk or branch as possible. The wound will heal more quickly and often will bark over, whereas stubs of any length will rot eventually. It is advisable to seal the exposed wood with asphaltum paint.

For shade trees, study growth habits. Some continue to branch from the leader, which never



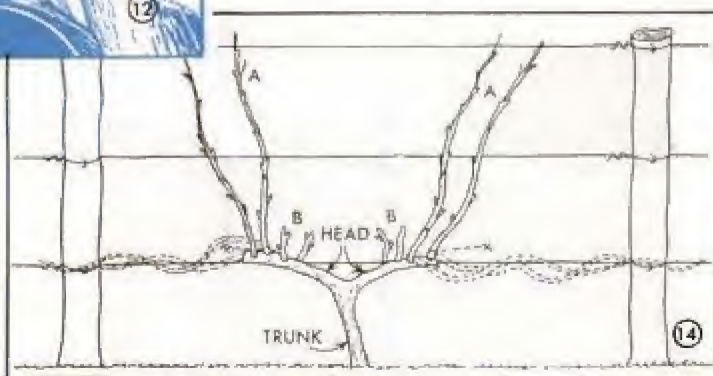


To prevent trunk injury when removing a large limb, make two cuts several inches from the trunk to drop the limb and then saw off the stub

height before taking the leader.

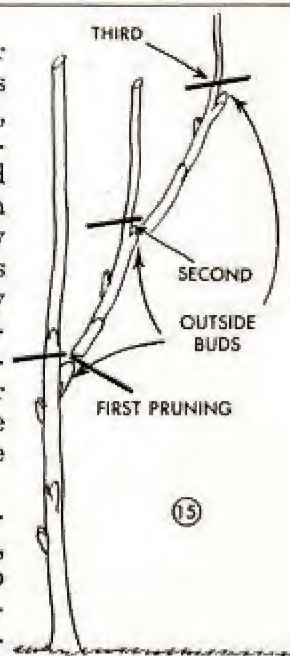
Flowering trees and treelike shrubs usually are treated similarly to fruit and shade trees. Heads of very dwarf trees and those inclined to an erect growth should be formed lower than those of fruit trees, and main branches can be much closer together. Dwarf trees growing taller and those having a wide spread can be framed higher. After the frame has formed, pruning should not be so severe as for most fruit trees, because the essential purpose of the latter is to bear large size fruit. Shrubs growing asunder (separate shoots coming from below ground) often are inclined to a vigorous and thick vertical growth, which can be corrected by removing some and pruning other shoots as in Fig. 15 to control growth in the direction desired. Matured shrubs of this kind and those growing from heads formed close to the ground

are kept in better flowering condition and within bounds not by pruning, but by encouraging new shoots to replace older ones which are cut back to the ground. This also is good practice on any shrub having growth habits like the familiar white spirea. All flowering trees and treelike shrubs can be divided into two classes: spring bloomers and summer-and-fall bloomers, each having different pruning seasons. White spirea, lilac, redbud, azalea, forsythia, dogwood, bush honeysuckle and pussy willow are among the many spring bloomers that, after flowering, grow new wood on which flower buds for the next season grow. If pruned in early spring much of their floral display is lost. It is best to prune them immediately after the blossoms have dropped.



Among the summer and fall bloomers are false spirea, weigela, rose-of-Sharon, spirea and hydrangea, which are pruned in early spring. Tender tops growing on hardy roots like the butterfly bush are likely to be winter killed and should be cut back to the ground in the fall.

Except for the removal of dead wood, evergreens need no pruning. Unlike deciduous (leaf shedding) trees, they

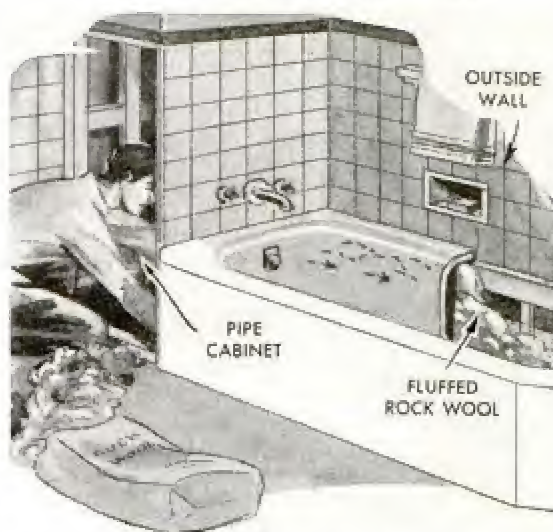


lack axillary buds, and therefore if cut back, they cannot grow replacements. However, if growth is a bit ragged, or if a certain shape is desired, soft-foliaged types such as arborvitae, juniper, hemlock and cypress can be sheared, but only after green growth has started in the spring, never in the winter, as the additional evaporation from the cut surfaces may kill them.

Among the several pruning systems for grape vines, the one illustrated in Fig. 14 is widely chosen because it is simple and produces renewal canes close to the head. During the latter part of each winter, but not when the vines are frozen, leave two or more long canes AA, having five to ten buds each, and cut a similar number of canes BB back to spurs having one or two buds each. Cut away all other growth. The long canes produce shoots that will grow the following summer's crop, while the short canes BB will become renewal canes that will bear crop of the second summer. Early in spring bring the long canes down and tie them as indicated by the dotted lines. Later reduce each short cane to a single strong shoot and tie to the upper supports. Repeat this procedure each season. Always select renewals on or as close to the head as possible. Often, these may be had coming from the trunk. The total number of buds that the long canes will carry depends on the soil, vigor of the plant, etc. If well established, the popular Concord grapes can carry fifty to sixty buds to a vine, whereas less vigorous varieties should be held to a maximum of twenty-five to thirty buds.

When planting young flowering vines, cut them back to induce more base shoots. Most matured varieties are handled much the same as shrubs. In summer, prune off straggling wisteria shoots, except those wanted for further climbing. Cut back new growth one third to induce flower-bearing spurs. In spring, cut back spring-and-summer blooming clematis as far as frost has killed the vines. Cut summer-blooming vines back to 2 ft. from the ground. Nearly all annuals and many perennials are improved by pinching off side shoots. Disbudding (removing surplus buds) produces specimen and show flowers. You need only a few pruning tools like those shown at the left of Fig. 10. Always use the tool that will do the job best, and keep them razor sharp as dull tools bruise the wood which is then likely to rot.

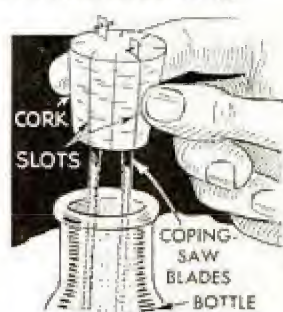
Insulating Between Built-In Tub And Cold Outside Wall



When a built-in bathtub is located against an outside wall, it should be insulated by packing the space between the tub and wall with a fluffed insulating material. In addition to protecting against danger of water pipes freezing during extreme temperatures, this also helps greatly in keeping the bath water at a uniform temperature. Frequently, tubs already installed can be insulated in this way simply by taking off the back of the pipe cabinet and forcing the material back of the tub.

Cork Supports Coping-Saw Blades In Bottle to Prevent Rusting

Where coping-saw blades are kept in a tall bottle to keep them from rusting, the cork provides an excellent means of supporting the blades so they can be removed quickly whenever desired.



Just cut or saw a number of slots in the side of the cork, insert the blades in them and then press the cork in place.

❑ Iodine stains can be removed from cloth by soaking it in photographer's hypo solution and then rinsing it thoroughly in running water. In the absence of hypo solution, a concentrated solution of potassium iodide in water can be used.

W. T. M. Concrete

Joints Between Concrete Blocks Shaped With Improved Tool



When pointing joints between concrete blocks, or laying up a new wall, and there is no regular tool for finishing the joints, one can be improvised from a length of angle iron. A drawer handle welded on the angle iron provides a good hand grip, although any suitable grip can be used if the tool is intended for only temporary use.

Roll-Up Table Cloth for Picnic From Shade on Suitcase

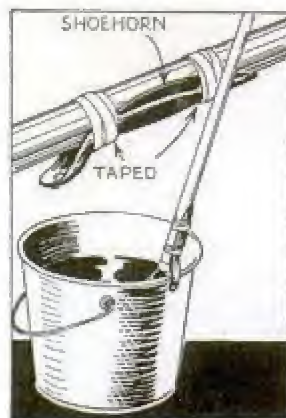
If you go on picnics frequently, an old suitcase with a window shade attached to it will be handy. The suitcase provides a carrier for food and other articles, and the shade serves as a table cloth when pulled



out on the ground and fastened down with a peg as shown. The shade roller is attached to the suitcase by means of the regular brackets, which are riveted in place.

Shoehorn Taped to Mop Handle Keeps It Vertical in Pail

Taped to the handle of a scrubbing mop, a shoehorn will slip over the edge of the scrub pail and keep the handle in a vertical position when the mop is not being used. Location of the horn will depend on the height of the pail. If the horn is bent to the contour of the mop handle, it will be easy to tape in place.



Numbered Paper Collar on Bottle Shows Time to Take Medicine

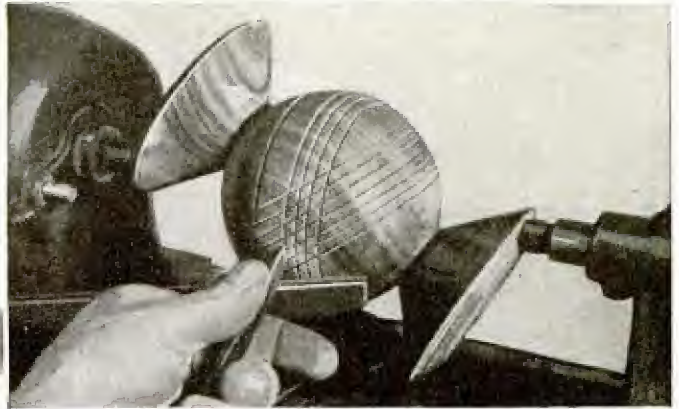


Anyone who experiences trouble in remembering the time to take medicine, can use a paper collar as shown to indicate the time. Number the collar from 1 to 12 and paint a small arrow on the neck of the bottle as indicated. Then each time medicine is taken, turn the collar so that the arrow points to the hour it is to be taken again.

Oil Preserves Paintbrushes

A new paintbrush suspended in raw linseed oil for a few hours before using it will be easier to clean. The porous bristles will absorb the oil, sealing themselves from moisture and thinners which make them flabby. This process is good only for brushes to be used in paints that contain an oil ingredient. The brush should be cleaned thoroughly to remove the oil before using it in paints having no oil content.

Diamond Ornaments Turned on Spherical Work



Turning diamond-shaped ornaments on opposite sides of spherical work, such as bowls, balls, etc., is not difficult and results in a beautiful job that shows outstanding craftsmanship. The bowl shown above is a good example. First, mount the stock between centers and turn the ball portion in the regular way, leaving waste stock at both ends shaped as indicated. Notice that the faces of the ends are beveled to provide flat surfaces for the lathe centers when the work is mounted at an angle between them as shown in the upper right-hand photo. Also, notice that a shallow groove is turned in each face as a guide in positioning the center. It is important that the groove be turned on each face in exactly the same position in relation to the center of the work so that the axis between lathe centers passes exactly through the center

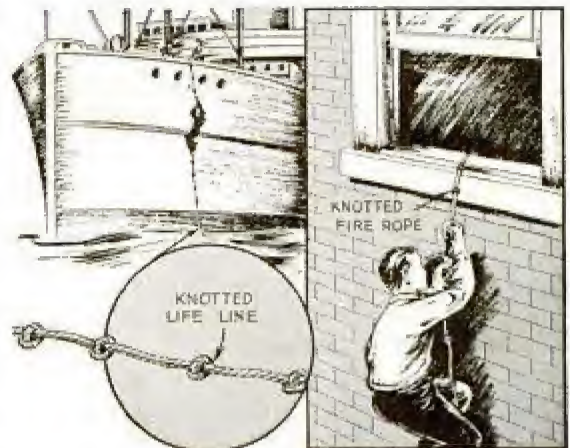


of the ball. Now, with the work mounted at an angle and the lathe running at slow speed, turn a number of shallow grooves in the ball. Then reverse the work end for end and turn another series of grooves. Finally, the ball is turned down, removing the grooves, and leaving the diamond pattern in relief as shown in the lower photo.

—Benj. Nielsen, Aurora, Nebr.

Life Line Is Easy to Climb or Slide Down When Knotted

A life line will be improved if knots spaced 12 to 14 in. apart are tied in it to aid in gripping it with the hands. This is especially true of lines used on piers, large private boats, or as fire ropes in homes where persons inexperienced in rope climbing may have to use them. Even a child that might not be able to grip a smooth rope tightly enough to support its weight can use a knotted one with ease. It is well to remember that the upper end of a rope used for these purposes must be attached to a firm support so there is no possibility of it pulling loose while in use and allowing someone to fall.



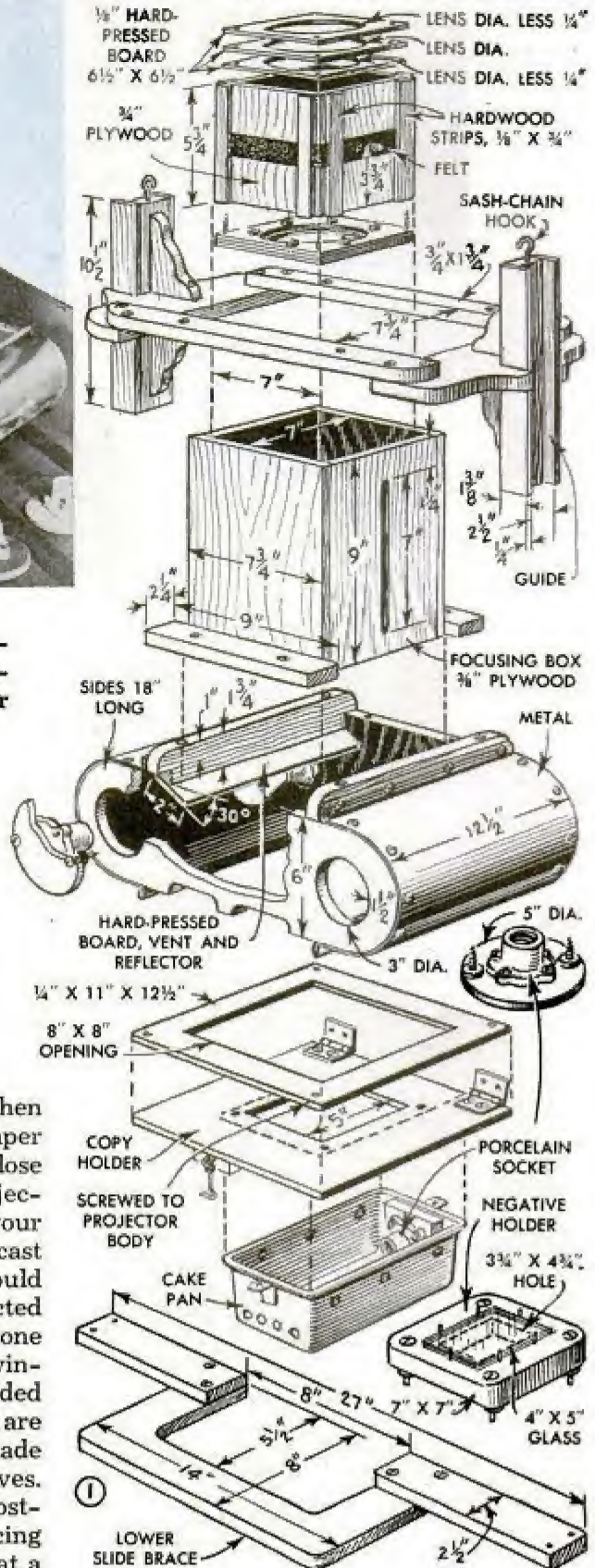


COPYING TABLE

Eliminates usual hand shadow by projecting image from below. Spring counterbalances equalize weight of projector to give a positive focusing action

By Edwin M. Love

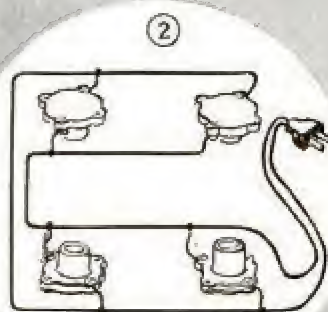
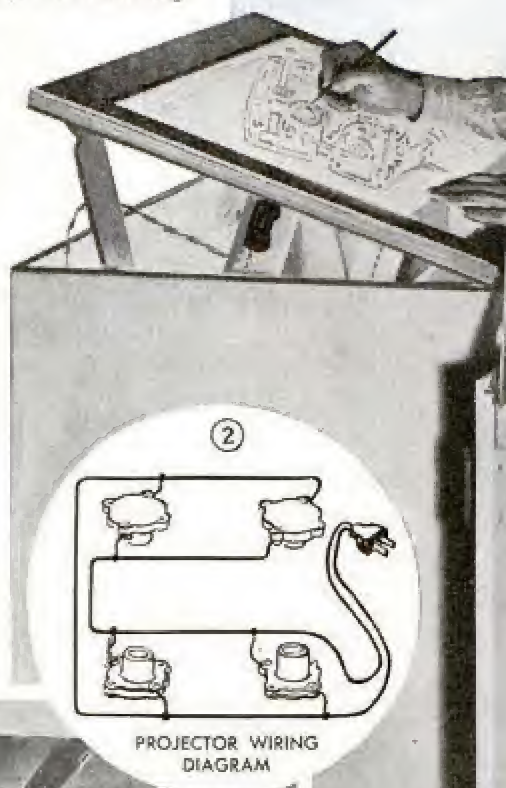
THIS multi-purpose "drawing camera" throws enlarged views of small patterns and pictures in magazines on tracing paper placed over a horizontal window, where it is an easy matter to trace them. You just place the picture in the copy holder as in Fig. 3, slide the projector up or down to get a sharp focus and then copy the picture or pattern on the paper held on the tracing window with cellulose tape. The advantage of having the projector mounted under the window is that your hand, when tracing the image, does not cast a shadow to obscure the work, which would be the case if the picture were projected from above. Direct copy work can be done by placing the picture on the tracing window and using the special lights provided for this purpose. Of course, best results are had in a darkened room. Provision is made also to copy enlarged views from negatives. Besides, the outfit can be used as a post-card projector by replacing the tracing window with a mirror, which is tilted at a



has built-in projector

45-degree angle to throw the picture on a wall or screen.

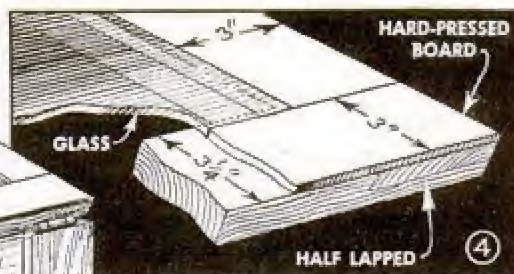
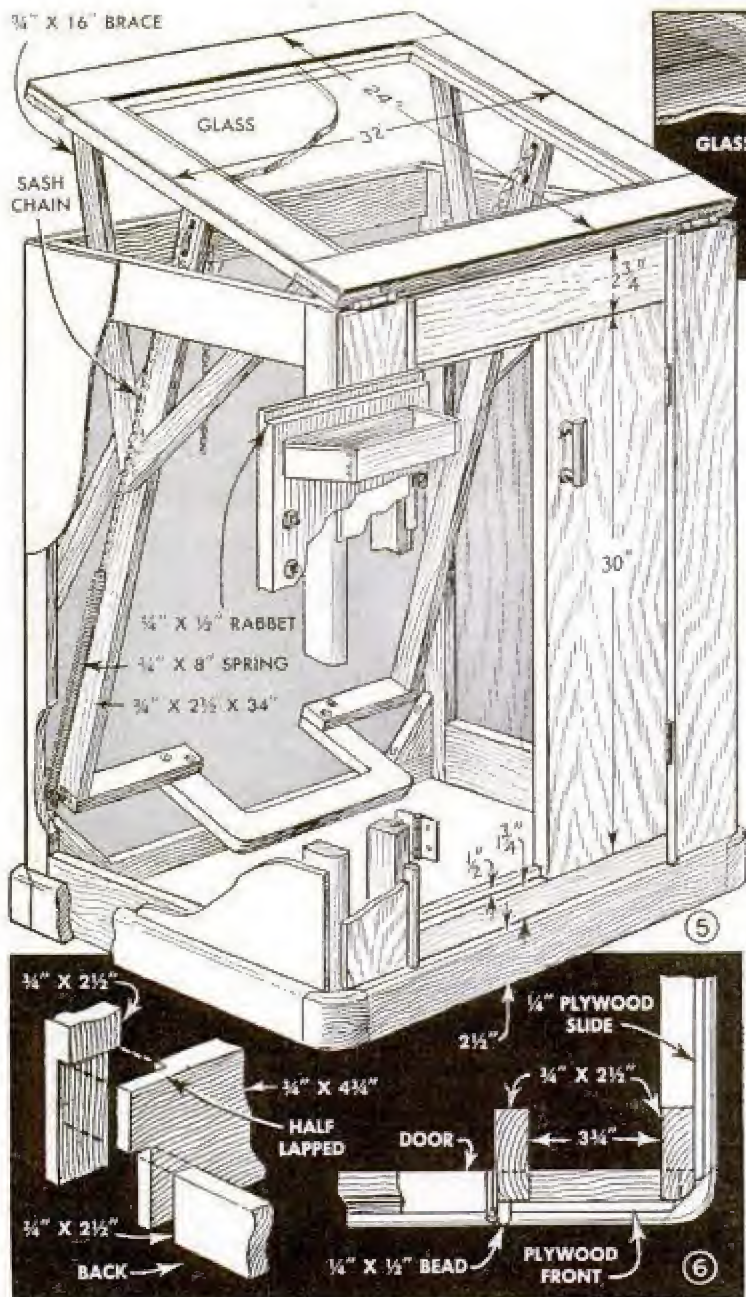
Construction centers around the projector itself, so start with this first. Fig. 1 shows the parts and their correct relation of assembly. If you cannot get plywood, use solid stock for the sides of the focusing box, lens holder and the lamp house. The latter, shown in the photo to the left of Fig. 1, has two beveled cleats across the top to which strips of hard-pressed board are fastened. These strips serve to deflect the light downward on the copy holder, and direct the heat out through the circular openings. Disks on which the porcelain sockets are mounted are spaced to stand out from the openings and provide vents. A few washers slipped over the screws will do the trick. Bright sheet metal salvaged from an oilcan



PROJECTOR WIRING
DIAGRAM



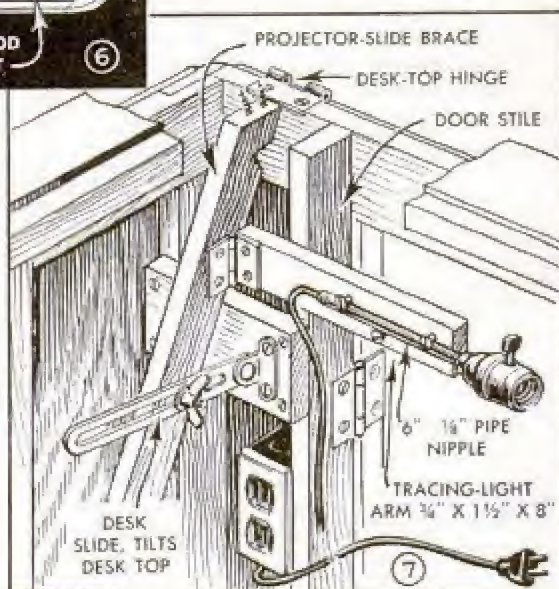
or similar container, will do to cover the rounded ends. You will notice that flanges are formed along the top and bottom edges of the metal, the top ones to permit attachment to the beveled cleats and the lower ones to overlap the edges of the copy holder. Wire the sockets according to Fig. 2, after first applying aluminum paint to



Although somewhat expensive, a corrected projector lens is the best. However, good definition can be had by using a camera lens. If you happen to have either a 4-by-5 Graflex or Speed Graphic camera lens with a focal length of about 5 in. and a speed of f:4.5 or better, it can be used in the projector by making a lens-board holder just like the one on the camera. Then you can use the lens from the camera on the projector, whenever needed. Sometimes a rapid rectilinear lens can be purchased reasonably from a pawn shop. A fourth choice would be the use of a pair of condensing lenses taken from an old lantern-slide projector. The upper detail in Fig. 1 shows how to mount a pair of these lenses. Each lens is sandwiched between two rings, the holes in

the inside of the lamp house. Next, you make the focusing box and the lens holder that slides inside of it. The latter is adjusted and locked by two wing nuts on bolts which project through slots in opposite sides of the box. After adding the hardwood strips at the corners of the lens holder, sand them down until a nice sliding fit is had and then wax both the strips and the inside corners of the box. Fill the space between the strips with felt as indicated, to stop light leakage.

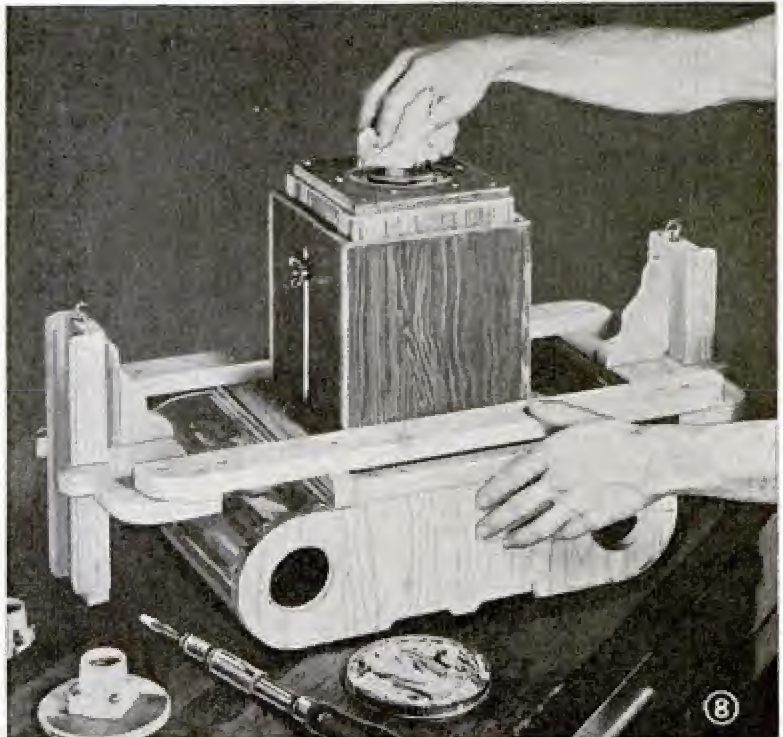
The efficiency of the projector depends on the quality of the lens used, especially if negatives are to be projected for tracing.



these being cut slightly smaller in diameter than a center one holding the lens. Usually these lenses have focal lengths of 6 and 8 in. Screw the 6-in. one to the bottom of the holder and the 8-in. one to the top, placing the convex faces outward.

Screws through the cleats on the focusing box are driven into the top edges of the lamp house and then the framework holding the channel-shaped guides is screwed to the top of the beveled cleats as shown in Fig. 8. Plywood is best for the two-piece copy holder. Screw the upper part of this to the bottom of the lamp house and hinge the lower part to it after you have attached the cake-pan reflector. Two or three screws are driven into the side of the lamp house to engage a hook on the lower part of the copy holder—one keeps the holder closed on a single sheet and the others provide space for magazines or catalogues. A holder for negatives is made to fit over the opening in the lower part of the copy holder as shown, four projecting bolts on the former engaging holes in the latter to keep it in place. Negatives are held between two pieces of glass which are centered over the opening with brads.

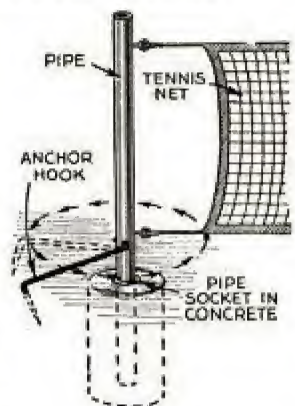
Now to make the cabinet: The cutaway view in Fig. 5 shows the vertical slides between which the projector travels. Being attached to the frame of the tracing window, they keep the projector at right angles to it, regardless of how much the top may be tilted. The brace joining the two slides at the bottom is U-shaped to permit further travel of the projector. Note in Fig. 5 how coil springs are used to counterbalance the projector. The springs are fastened to the outside lower ends of the slides and the chains, passing over standard sash pulleys fitted in the upper end of the slides, are hooked, under slight tension, to the channel-shaped guides of the projector. To work properly, the guides must fit the slides rather snugly. Desk slides, Fig. 7, lock the window at the desired slant. Fig. 7 also shows how two lights are in-



stalled, one at each side, on hinged arms to give illumination for direct tracing. On the original model 25-watt lamps were used here, a 150-watt lamp in the negative reflector and four of 100-watts in the lamp house. As shown in Figs. 5 and 6, the cabinet consists of a half-lapped framework fitted with doors at the front and covered with either $\frac{1}{4}$ -in. plywood or hard-pressed board. Strips of the latter are used around the top of the window frame to retain the glass as shown in Fig. 4.

Tennis Net Is Tightened and Held By Strong Anchor Hook

To tighten and hold a tennis net, where a ratchet adjustment is not provided, set one of the posts in a pipe socket and drill the post to receive a strong anchor hook. This hook is made by bending a length of iron rod to the shape indicated. It is used as a handle to turn the post and tighten the net ropes after which it is forced into the ground to hold the tension.



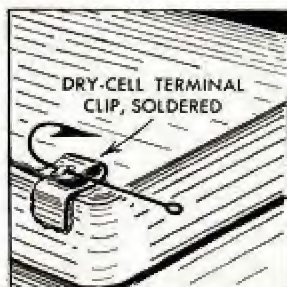
W.T.M. Concrete

Door Wedge Stabilizes Desk Slide To Hold Adding Machine



If you use an adding machine or typewriter on a desk slide, the latter can be supported rigidly by simply pulling out the top drawer of the desk and forcing a wedge between it and the slide. Where rubber doorstops are available, one of these will be ideal for the purpose. If the space between the slide and drawer is too great, a wooden block can be attached to the stop.

Fisherman's Emergency Fly Vise From Dry Cell Clip



Soldered to the edge of your tackle box as indicated, a clip from a dry cell provides a handy vise for holding a hook while tying a fly. Such a vise is always at hand and

ready for instant use, even when you are away from home on a fishing trip.

Keeping Ants Out of Your Home

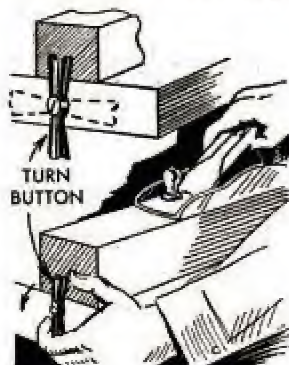
After trying unsuccessfully for several years to keep ants out of our home, we found the following mixture highly satisfactory. It consists of sodium arsenate, $\frac{1}{2}$ oz., sugar, 1 lb., and sirup or honey, 1 tablespoonful stirred into water $1\frac{1}{2}$ pts. As this solution is poisonous it must be used in feeders or containers of a type that will prevent children and small animals from getting at it. Place the feeders in a safe

place near the ant trail and your home will soon be free of ants.

—C. L. Stevenson, North Hollywood, Calif.

Turnbutton Serves as Bench Stop

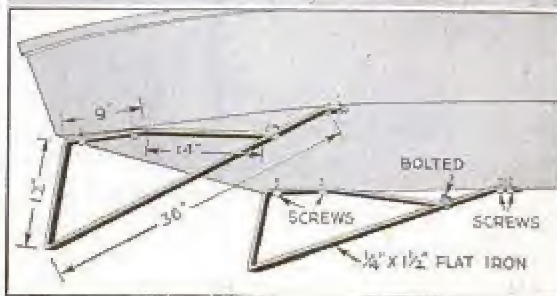
Needing a stop on his workbench to hold small work while planing it, one craftsman used a metal turnbutton for the purpose. This was screwed to the end of the bench top as shown, where it could be turned to a horizontal position parallel with the edge of the bench to keep it out of the way when not in use.



Flat-Iron Skids at Stern of Boat Shield Motor Against Logs

Damage to an outboard motor by having it strike submerged logs and rocks in a shallow lake, can be avoided by fitting it with these skids, which act like sled runners to raise the stern over any obstruction. Bolted to the bottom of the boat, the skids are thin enough to offer very little resistance to the forward movement of the boat. Also, if you drag your boat across a narrow strip of land from one lake to another, the skids will be helpful.

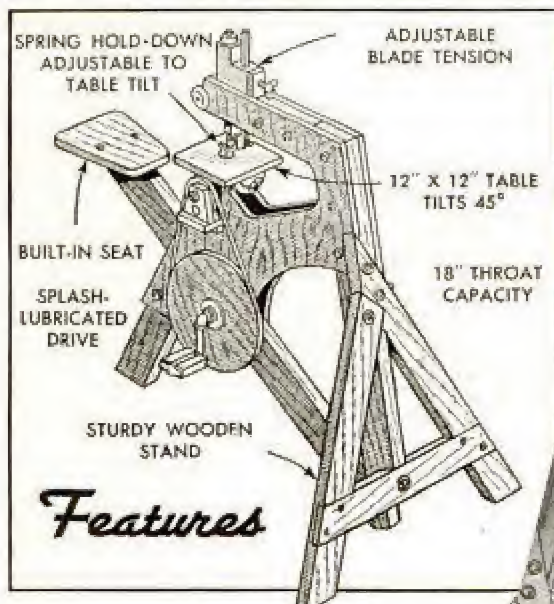
—Stanley K. Wood, Hot Springs, Ark.





SHOP NOTES

Foot-powered SCROLL SAW



Although designed to be pedaled like a bicycle, you can use a motor to run this sturdy scroll saw. It is built almost entirely of wood, has splash-type lubrication, adjustable blade tension and other features as shown above

By Wayne C. Leckey

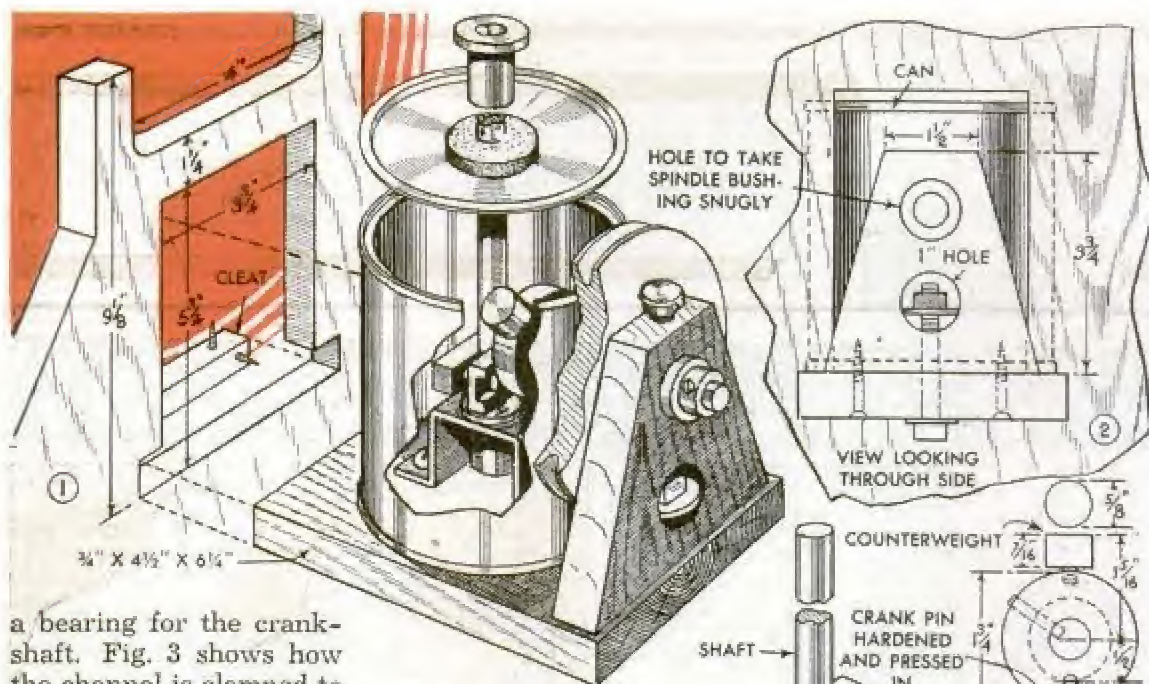
PART I

SCARCITY of metal need not keep you from having a scroll saw, as this one is made mostly of wood. Aside from the bolts and bushings required, the few other pieces of metal needed can be salvaged, in most cases, from odds and ends found in the junk box. If plywood is not available in your particular locality, you can resort to solid stock by gluing up panels of sufficient width. The crankshaft mechanism of the



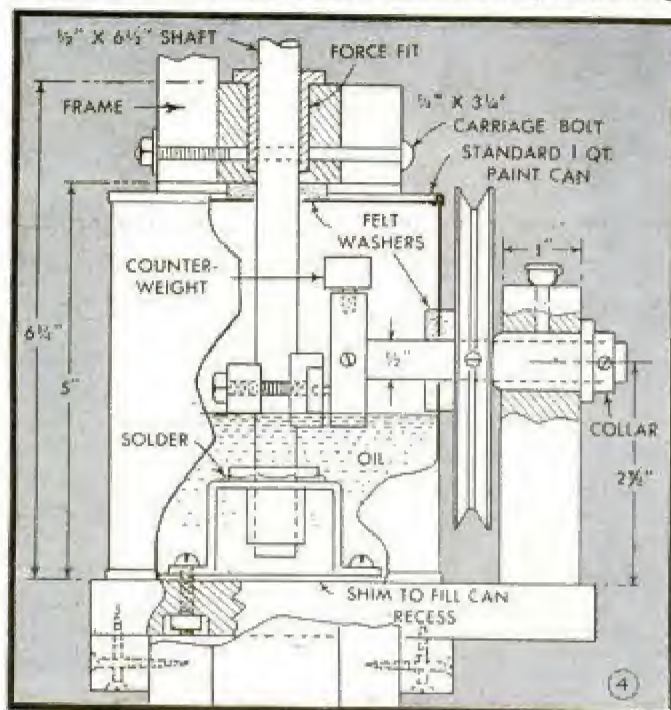
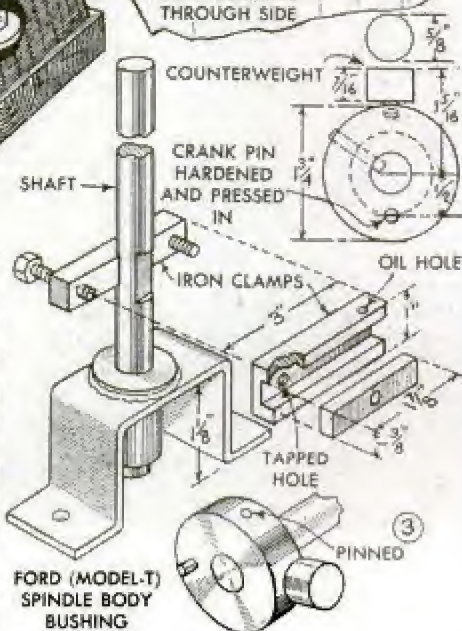
drive head operates in a bath of oil and is sealed inside an ordinary 1-qt. paint can of the type having a press-fit lid. Fig. 4 will give you an idea of how it works. A crankshaft, entering the side of the can, engages a bar, which slides back and forth in a channel clamped to a vertical shaft. This produces a smooth reciprocating motion of the shaft, much like a piston, the stroke being 1 in. Oil in the bottom of the can is splashed by the crankshaft to keep the mechanism well lubricated.

The complete drive unit is shown in Fig. 1, partly cutaway so that you can get a better idea of its assembly. Bronze spindle bushings (Ford model-T type) are used as sleeves for the vertical shaft and also as

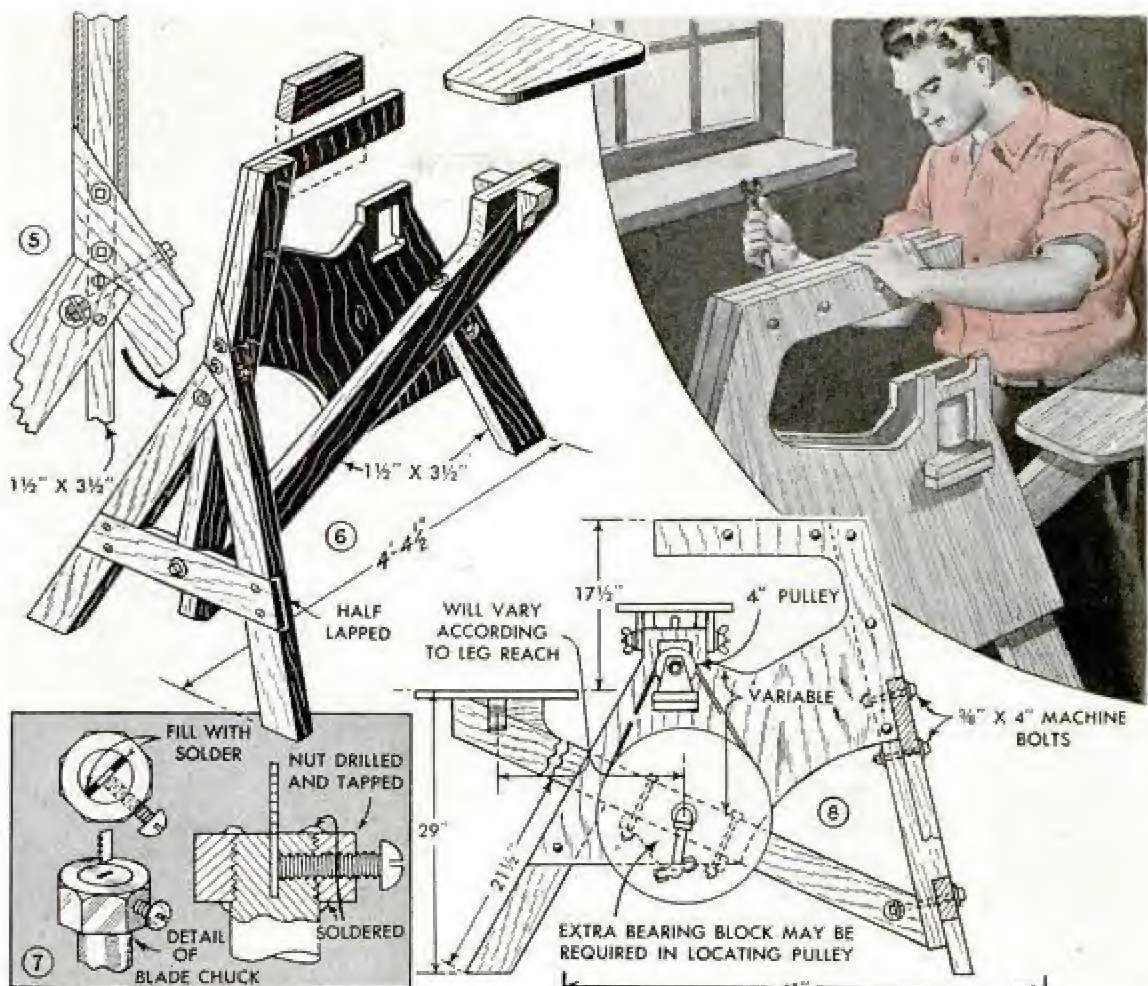


a bearing for the crankshaft. Fig. 3 shows how the channel is clamped to flattened places on the shaft, and how the lower bushing is mounted in a flat-iron bracket. Note from Fig. 4 that the bolts in the latter fasten both it and the can to the wooden base. You can work the channel to shape by hand using a hacksaw, chisel and file, or you can have the channel and crankshaft made. Thick felt washers prevent leakage of oil at points where the two shafts pass through the can. The oil level, of course, should be kept below the hole in the side of the can, as shown in Fig. 4.

It is important that the block holding the crankshaft bearing be rigid. Fig. 2 shows a way of bolting

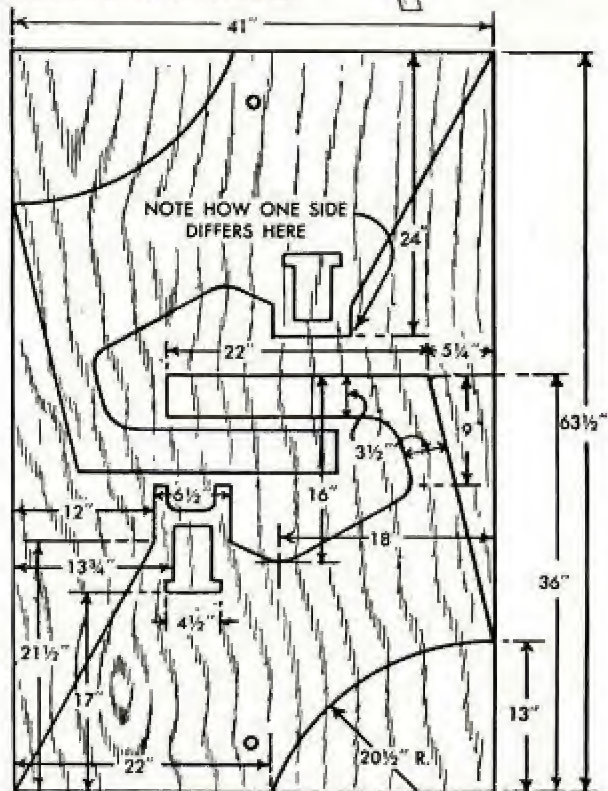


this, which allows it to be retightened easily if it should work loose. When installing the crankshaft there must be no end play, as the face of the disk, bearing slightly against the channel, keeps the bar engaged in the latter. It also prevents twisting of the shaft and saw blade, which would cause the latter to break. So, see that the set-screws in the pulley and the collar are tightened securely to the shaft on each side of the bushing, without side play. If desired, you can make the pulley of wood and pin it to the shaft. Before the lid can be pressed on the can, the upper end of the shaft must be threaded and slotted, so that a blade chuck like the one detailed in Fig. 7 can be fitted to it after the upper bushing and the filler block in which it

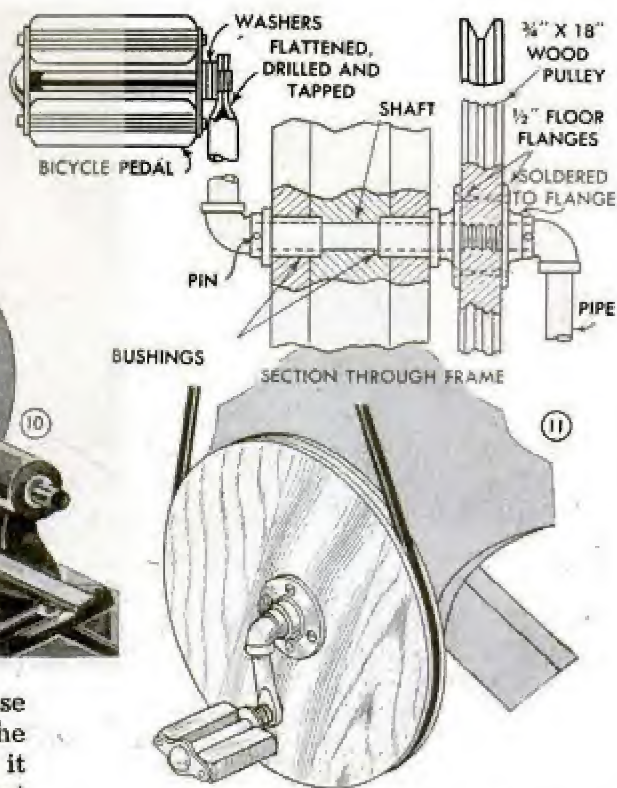
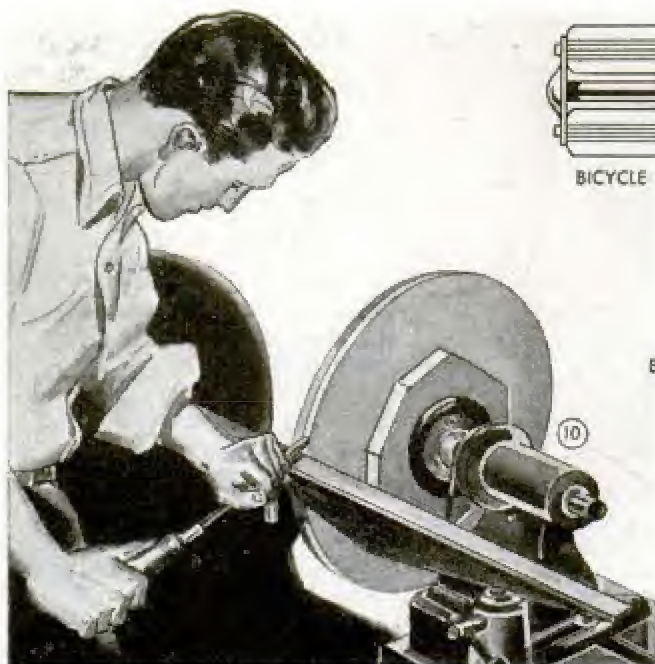


fits, have been slipped over the end.

You can set the drive-head unit aside for the time being, and proceed to make the wood stand. Plywood is preferred but solid stock can be used. Fig. 9 shows how both side pieces can be laid out economically on a 41 by 63½-in. panel, after which the two can be cut apart roughly with a compass saw and then trimmed to exact size. The size of the opening in which the drive head fits is given in Fig. 1. Note that the left-hand side has projections above the opening, which serve as stops for the tilting table. The frame or core to which the side pieces are glued and bolted is made up of common 2 by 4-in. material. Fig. 6 shows the arrangement of the pieces, while Figs. 5 and 8 detail how the rear legs are fastened rigidly with bolts and screws. The member which extends to form a seat is bolted to the front and rear legs in the same way as used in the drive head. As individual leg reach varies, the length of this piece will have to



⑨ HOW SIDES CAN BE LAID OUT ECONOMICALLY



be determined by trial. This is likewise true in locating the bearing hole for the large drive pulley. For some persons it may be satisfactory if centered in the seat member as in Fig. 8; for others it may be necessary to fit an extra block as indicated to permit lowering the position of the pulley to a point where it is easy to pedal.

Assemble the stand as far as shown in Fig. 6 and then slip the drive unit into the opening provided for it before putting the opposite plywood side on the frame. This of course, will necessitate removing the pulley and the wood bearing block. In doing this, be careful that the pin in the crankshaft does not disengage the bar. Cleats are used in the manner shown in Figs. 1 and 4 to fasten the drive unit in place, after which the filler block containing the upper bushing of the shaft is bolted flush with the top of the plywood sides. With this filler block in place, you can go ahead and add the blade chuck to the slotted end of the shaft. This consists of a hexagon nut screwed and soldered to the end and then drilled and tapped crosswise for a setscrew to clamp the blade as shown in Fig. 7. The blade can be made self-centering in the chuck by filling the slot with solder on each side of a piece of wood that is the same width as the blade.

The sectional view in Fig. 11 shows how the large drive pulley is held to a $\frac{1}{2}$ -in. pipe shaft by two floor flanges which are centered and screwed opposite each other. One end of the shaft is threaded to pass

through the flanges far enough to permit a $\frac{1}{2}$ -in. elbow to be pinned to the projecting end and soldered to the flange. If you are unable to have the bushings turned of metal to fit the pipe shaft, satisfactory ones can be turned of hard maple and replaced at signs of wear. If metal bushings are used, they should be a press fit in the stand. Bicycle pedals attached to flattened ends of short pipe arms make a neat job. Owing to the size of the plywood drive pulley, you'll have to true it on the outer end of the lathe as shown in Fig. 10.

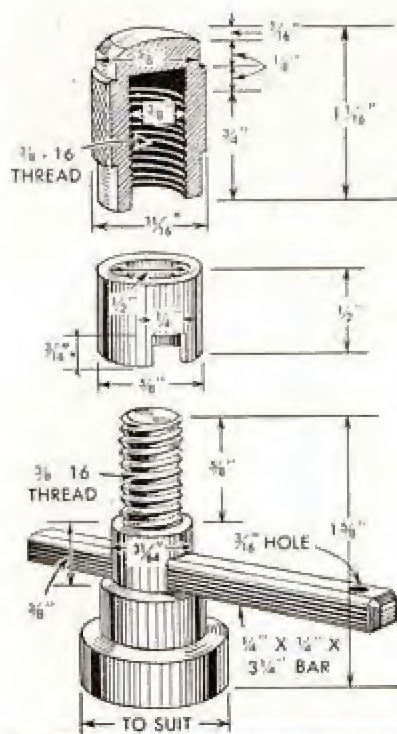
(To be continued)

Claw Hammer in Vise Holds Rods For Pointing With File

When pointing rods with a file, one mechanic uses a claw hammer as an improvised vise to hold the rods so they can be rotated easily as the work progresses.

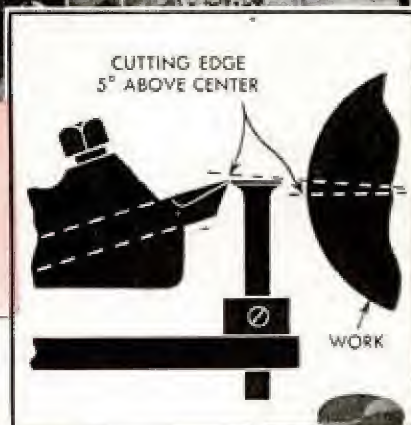
The hammer is clamped in a regular bench vise for rigid support while the rods are held in the claws, one hand being used to turn the work as the other one operates the file.





HEIGHT GAUGE *to center tool bits*

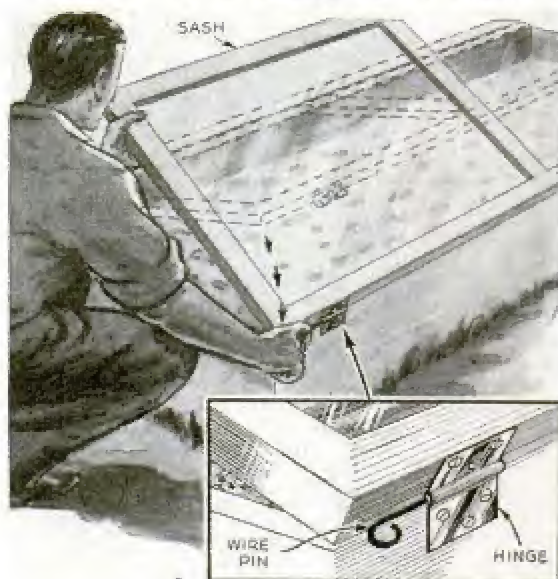
LOCKED in a lathe tool-post slot where it is ready for instant use, yet is out of the way when not needed, this gauge will enable an inexperienced lathe operator to center a tool bit accurately. Also, the gauge will save time for an experienced operator, for the gauge arm can be swung horizontally to the bit position for adjusting the latter, after which the arm is swung back out of the way. Requiring only a small amount of steel, the gauge can be made from scrap pieces, and consists of the four parts shown in the upper left-hand detail, plus a centering tip and collar as shown in the lower detail. A base turned to fit the tool-post slot and threaded at the upper end, has a hole through it to take an arm which carries the centering tip. Horizontal adjustment of the arm is held by a slotted collar, which is tightened against it by a turned nut or cap. The centering tip carries a movable collar, which is held by a setscrew so that the exact center of your lathe can be obtained from the headstock



center, after which the collar is adjusted to hold the tip to the correct height. It is a good idea to check the tip against the headstock center occasionally to assure that it is in the correct position. As the original gauge was made for one particular lathe, it may be necessary to increase or decrease some of the dimensions proportionally, especially the diameter of the base, for a gauge to suit various lathes.

—W. T. Warde, San Francisco, Calif.

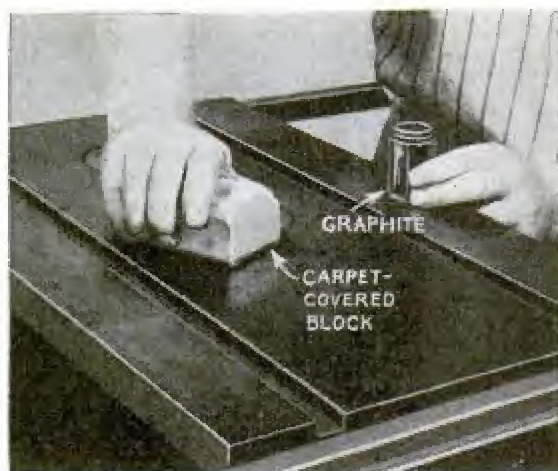
Hotbed Sash Lifted at Both Sides If Loose-Pin Hinges Are Used



Being unable to raise his hotbed sash on some days because of chill winds blowing toward the opened side, one gardener hinged both sides of the sash so that either could be raised to deflect the wind. Loose-pin hinges were used, pieces of heavy wire with eyes formed on the ends being used as pins to permit easy removal.

Metal Surfaces Are Rustproofed By Polishing With Graphite

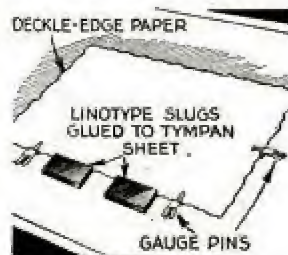
Polished steel surfaces that are exposed to the weather or to the action of coolants can be given a waterproof coating by sprinkling them lightly with finely powdered graphite, and then rubbing them briskly with a piece of carpeting glued to a block of wood. A surface that has already rusted should be scoured with coarse steel



wool and dressed down with emery cloth used dry. Rub the surface until all tiny rust pits have been worn down. Then apply the graphite generously and rub it well into the surface with a hard felt pad. The resulting finish will be black and have a high luster.—Alexander Maxwell, Chicago.

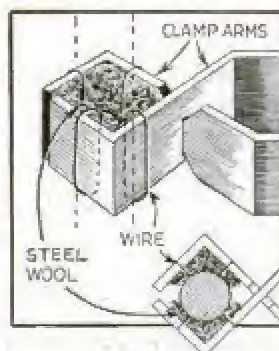
Printing of Deckle-Edge Paper Speeded by These Guides

Feeding of deckle-edge paper stock on a job press is often difficult because the rough edges catch on the gauge pins and interfere with sliding the sheets



into position. One printer avoids this trouble by gluing a couple of linotype slugs onto the tympan sheet. These are placed so that they project slightly beyond the centers of the gauge pins yet allow the tongues of the pins to hold the stock. The rough sheets slide easily against the smooth edges of the slugs.

More Heat From Carbon Welder



With most types of low-voltage carbon welding torches, the clamp for holding the carbon permits contact at only three or four points instead of all the way around, and when the contact areas become filmed or corroded, high resistance is set up against the passage of current. An improvement for a torch of this type is to bind a small quantity of steel or copper wool to the inside of each clamp arm, using small wire to fasten it securely. The wool allows contact all around the carbon, thus providing maximum heat at the tip.

Preventing Electrical Terminals Overheating and Annealing

I have found that trouble caused by friction terminals on toasters, electric irons, etc., becoming hot and annealing because

of high electrical resistance, due to rust and corrosion, can be eliminated by tinning (brazing) the terminals with bronze or brass. This makes a low-resistance connection and does away with rust and corrosion that is normally encountered on untreated pin terminals.

—R. K. Beal, Marion, Ohio.

Emery-Cloth Knife Sharpener On Paperhanger's Table

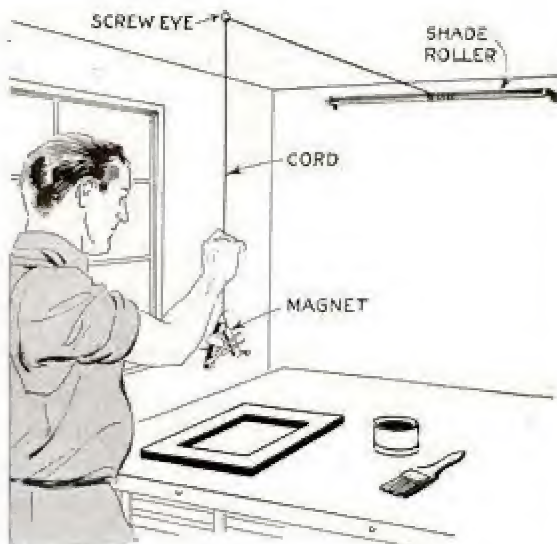


A convenient sharpener for a paperhanger's knife can be made by sawing slits in one end of the table top through which a strip of

emery cloth can be threaded as indicated. No tacks are necessary to hold the cloth, which may be changed easily when worn.

Printer's Tools Held by Magnet Above Imposing Stone

To keep his make-up rule, bodkins, tweezers, etc., conveniently at hand over the imposing stone in his shop, one printer uses a large magnet. This is suspended from the ceiling by a cord which passes through a screw eye and over to a window-shade roller attached to the wall. This arrangement permits the magnet to be pulled down where it is within easy reach or raised out of the way when not needed. If desired, a counterweight can be used instead of the window-shade roller.



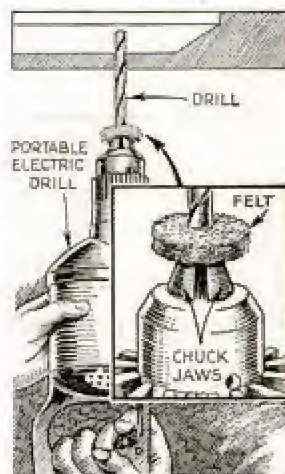
Easy Way to Dissolve Chemicals In Spraying Solutions



One orchardist saves time when dissolving chemicals to make up his spraying solutions by putting the chemicals in a discarded corn popper and swishing them back and forth in the liquid. In this way, the chemicals are dissolved more rapidly than when dumped into the water and stirred with a paddle.

Fouling of Drill Chuck Prevented By Small Felt Disk

When using an electric drill in an inverted vertical position one mechanic experienced trouble by having chips work down the drill flutes and get into the chuck. To prevent this, he slipped a thin felt disk over the drill close to the chuck. The felt absorbed the excess lubricant, which runs down the flutes carrying the chips with it. It will be a good idea to have extra washers at hand so they can be changed when saturated with oil, otherwise centrifugal force will sling the oil around.—W. C. Lammey, Sandwich, Ill.



CONSERVE *by Repairing*

SALVAGE FOR VICTORY!

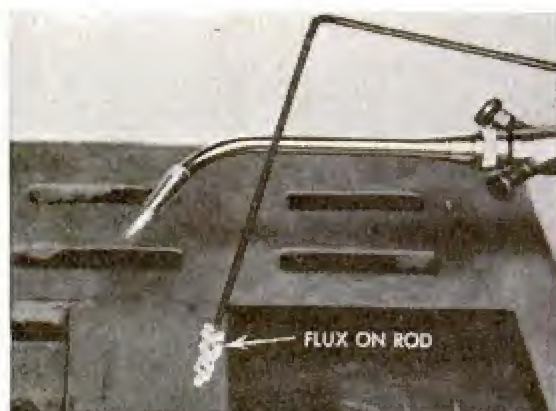
Every machine shop can help to divert more metal, time and equipment for use in essential war production by applying more stringent measures to assure the greatest possible amount of salvage of worn and broken tools and machine parts, instead of scrapping and replacing them with new parts.

By H. J. Chamberland

AMONG repair methods to renew worn and broken tools and machine parts so that they will give continued, useful service, are three outstanding processes, as follows: 1—Bronze welding with an oxy-acetylene torch to resurface or rebuild. 2—Hard chromium plating to replace worn surfaces and produce hard-wearing surfaces. 3—Regrinding cutting edges of high-speed tools, better known as cutter salvaging.

Bronze welding: This process is extensively used to build up worn or broken sections of steel, cast iron, malleable iron, copper, brass and other metal tools. Bronze welding differs from most other types of welding in that it produces welds of exceptional strength without fusion of base metal. Because of less heat required, bronze welding is faster and therefore gas consumption is reduced. Preheating cast iron is often unnecessary but if it is advisable, it need not be extended beyond a black heat so that expansion and contraction are minimized. A special bronze welding rod is used, which melts quickly and flows freely at 1600° Fahr. It tins easily, hardens rapidly and can be machined readily.

Tinning: The secret of bronze welding lies largely in the tinning or preparatory operation. The surfaces to be tinned must be cleaned thoroughly, as molten bronze will not flow on dirty metal. The appren-



① FLAME ADJUSTMENT FOR SLIGHT OXIDATION



② HEAT SMALL SPOT TO BRIGHT RED



③ END OF ROD MELTED ON RED SPOT



④ DEPOSITING A LAYER OF BRONZE

METAL Shop Tools

tice can practice tinning as follows: Get a couple of $\frac{1}{4}$ -in. low-carbon steel plates about 8 in. square. A section about 3 in. wide should be surface-ground or highly polished. Use a light blowpipe, recommended bronze and related flux. Adjust the flame for slight oxidation, bend the bronze rod for convenient handling, heat the end of the rod about 2 in. and dip it into the flux so that a sufficient amount will adhere to the rod as shown in Fig. 1. Next, as shown in Fig. 2, hold the flame near the edge of the plate and heat a small area about the size of a dime to a bright red. Then, as shown in Fig. 3, melt the flux end of the rod on the red area. The metal should now spread evenly in a thin film. The small dark spot readily seen under and ahead of the flame represents the tinned area. Keep working from left to right continually depositing a layer of bronze about $\frac{1}{8}$ in. thick and $\frac{3}{4}$ in. wide as shown in Fig. 4, alternately dipping and raising the rod from the puddle so you can get the flame under the rod to allow the deposit ahead to thin out.

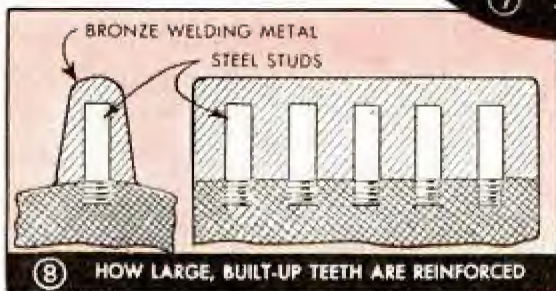
Building up broken gear teeth: Building up broken or worn sections with bronze weld is known as surfacing. A common application is to renew broken teeth of a gear as shown in Figs. 5 and 6. With this method, thousands of costly cast-iron gears can be salvaged at slight cost. In doing this, the fractured surface is filed and polished, then heated to a cherry red and tinned. A tooth can



⑥ BUILDING UP NEW TOOTH



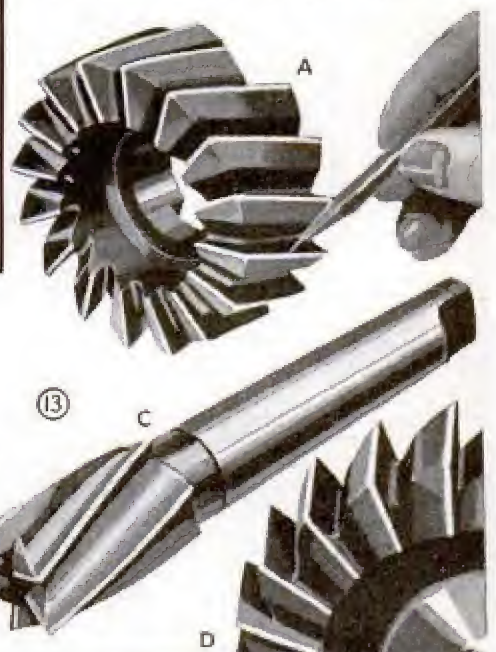
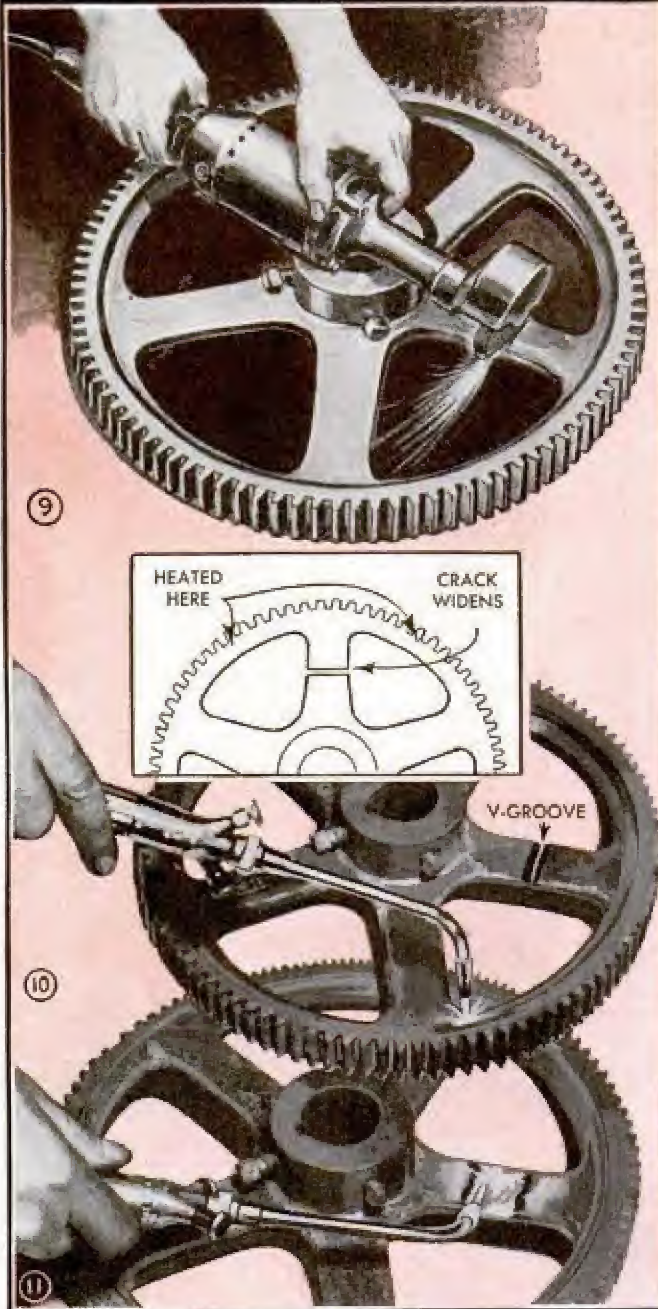
⑦ FINISHED TOOTH



⑧ HOW LARGE, BUILT-UP TEETH ARE REINFORCED

be built up as shown by depositing the bronze in a series of ripples each about $\frac{1}{8}$ in. thick. Direct more heat to the rod than to the deposit. You can start with a $\frac{3}{16}$ -in. rod and finish with one $\frac{1}{8}$ in. in diameter to better accommodate the gradual narrowing of the tooth. Fig. 7 shows the bronze-weld tooth after it has been machined to shape. It is stronger than adjacent teeth, having a tensile strength of 50,000 lbs. per square inch. When two or more large teeth have to be built up, the following procedure is advised: After filing the fractured surface

REPAIRING CRACKED GEAR



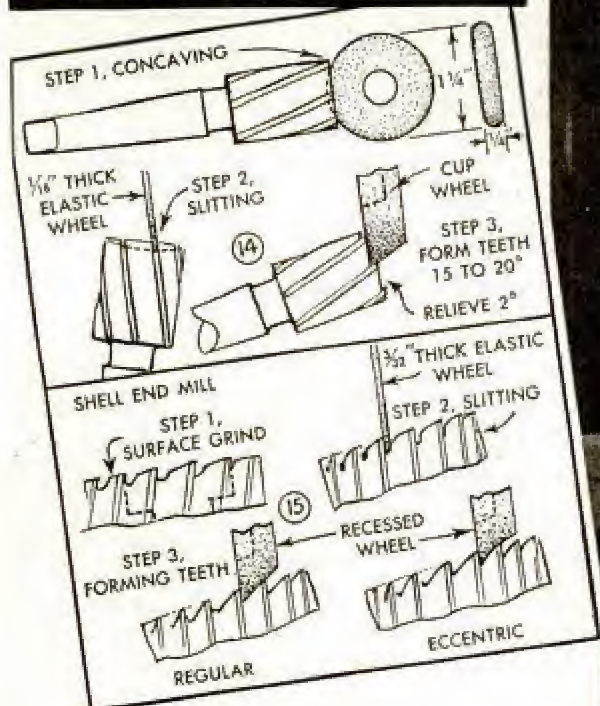
TYPES OF CUTTERS EASILY SALVAGED IN ANY MACHINE SHOP

smooth, the gear is drilled and tapped for reinforcing steel studs along the line of every missing tooth as shown in Fig. 8. Gear teeth so reconstructed may either be finish-shaped by milling, or by filing to template size.

Cracked gears: When a spoke of a cast-iron gear breaks, a bronze weld solves the problem of saving the part. Such a fracture is ground to a V-shape for increasing the strength of the weld, as shown in Fig. 9. Note that the rim of the gear is heated close to adjacent spokes, Fig. 10, which slightly opens the crack as shown in the insert. Then the metal adjacent to the crack is tinned and heated after which the bronze weld metal is applied as illustrated in Fig. 11. Then the gear is turned over and welded on the opposite side.

Hard chromium plating: Hard chromium plating differs from decorative plating in that the former requires but a perfectly smooth and clean surface of base metal, whereas the latter requires an intervening layer of nickel. Broaches, taps, reamers, facing tools, jig bushings, drills, files, dies of all kinds, most types of gauges, shaft bearings and other items are surfaced with this process. Plug

RECUTTING TEETH OF END MILLS

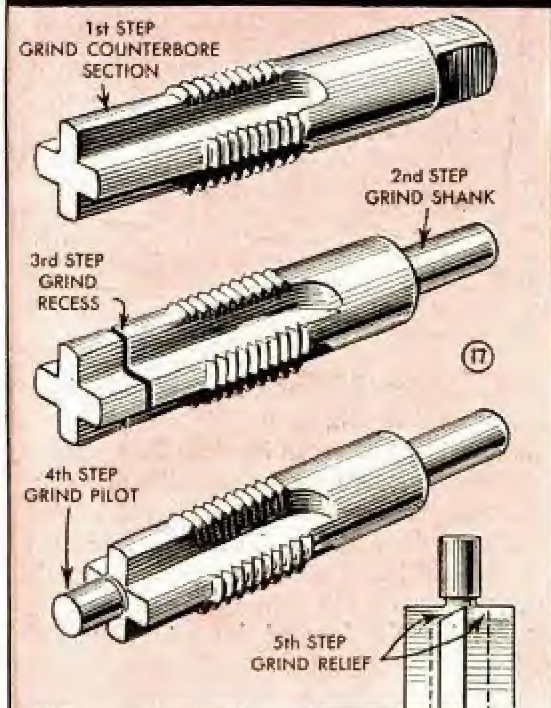


gauges that are worn undersize can be hard chrome plated at approximately 20 percent of the cost of new tools. The primary step is to true them cylindrically by grinding, the removal of .0015 to .002 in. of stock usually being sufficient. Then the tools are plated .0003 to .0005 in. oversize and lapped to exact dimensions. Motor-shaft bearings are often given a .004 to .006-in. plate to allow for finishing to size. Snap and journal gauges as well as reamers are the most economical chrome-plating applications. Many new tools such as files are chromium plated. It has been found that such files given a .0002-in. of hard chrome plate will last three or four times as long as the common unplated kind. Also chrome-plated drills and facing tools will last six to eight times longer between grinds than the usual kind.

Cutter salvaging: When depth of flutes of milling cutters, side mills, end mills and shell end mills, has been reduced one third from successive sharpening operations, the tools have lost approximately 25 percent of their original cutting efficiency. The reason is a gradual reduction of chip clearance besides feed and speed changes. Generally, cutters can be reground twice and only cutters made of high-speed steel can be ground because the steel is hardened all the way through. All the mills that are shown in Fig. 13, can be salvaged easily



COUNTERBORE MADE FROM TAP

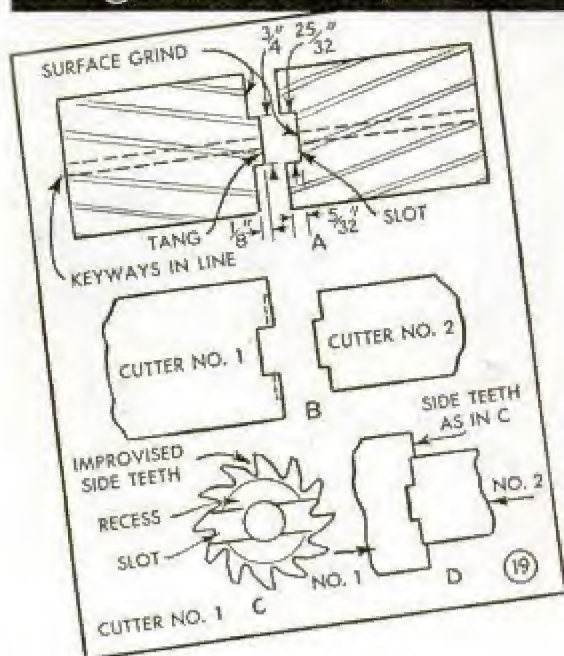


in any machine shop but cutters over 2 in. thick should be sent out to shops specializing in this kind of work. When done outside, the cost of regrounding is 50 percent of the prevailing price of new tools of the same type and recut diameter. Cutter salvaging in one shop is done for 20 to 30 percent of new tool costs. When the teeth of cutters originally are milled in a single traverse movement past the milling cutter, the salvaging procedure requires a series



(18)

DISK PLUG GAUGES MADE FROM OLD SLITTING SAWS



of repeated cuts around the circle to obtain the desired depth.

Recutting the teeth in straight cutters is done with a cup wheel shaped to the angle that will produce the desired depth of flute, as shown in Fig. 12. Peripheral teeth of the side mill in Fig. 13-D can be recut this way, and any tooth shape may be produced by shaping the face of the grinding wheel accordingly. The side mill shown in Fig. 13-B can be recut by setting the machine table at the correct angle and using two different wheels with different angles to reproduce the original shape of the teeth. The shell end mill in detail A and the end mill in detail C would never require recutting peripheral teeth if the end teeth were given constant attention. For recutting spirally milled teeth in any mill, it is necessary to use the same attachment as for sharpening spiral hobs to reproduce correctly the angle of spiral. The simple procedure of cutting new teeth in end mills as shown in Fig. 14 also applied to reshap-

ing end teeth in shell end mills as shown in Fig. 15. The reason for using the elastic or rubber-bonded wheel is that it spaces rapidly and saves the corners of the actual gumming wheel. To recut spiral teeth, a straight wheel having a 1/2- or 3/4-in. face is used. The diameter must not exceed 4 in. and the face must be

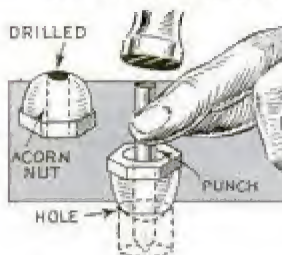
dressed to a compound angle to reproduce the original milling cutter used.

Tool transformations: After a metal-cutting tool has served its original purpose, it is not necessarily ready for the scrap pile. The high-speed counterbore shown in Fig. 16 has been made from a tap no longer of service. Steps to transform the tool are shown in Fig. 17, the work being mounted on centers. The grinding operations require less than 45 minutes.

Fig. 18 shows an assortment of disk plug gauges made from discarded high-speed 1/4-in. slitting saws. This set of gauges was made for approximately 20 percent of what new gauges of this type would cost. Holes are of one diameter for single-handle convenience.

Two milling cutters of identical diameters can be made interlocking in less than an hour's time, as described in Fig. 19A. This procedure has saved the cost of a new cutter to mill a wider surface. Cutters of different diameters are interlocked as in detail B. The larger mill requires side-cutting action as shown in details C and D.

Duplicate Holes Marked Easily With Acorn Nut and Punch

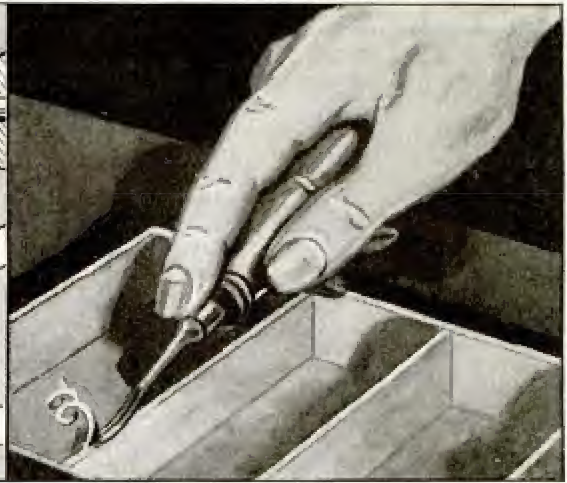
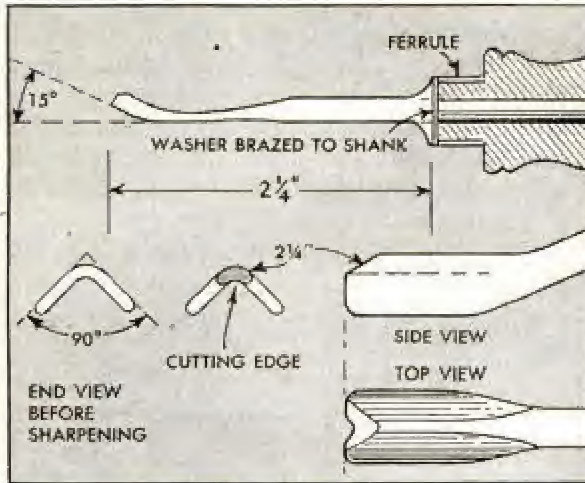


Where new work is being laid out from a pattern and suitable tools are not at hand for marking the metal to drill duplicate holes, these marks can be made easily

with an acorn nut and an ordinary punch. All you need to do is drill the nut and slip it over the end of the punch to provide an attachment that will center the punch accurately when held vertically in the holes.

—A. H. Waychoff, Phoenix, Ariz.

This Tool Rounds Edges of Woodwork Quickly



Woodworkers will find this tool a time-saver for rounding sharp edges, especially on work that has dead ends such as drawer sides, partitions, etc. The tool is made from two old twist drills welded together end to end. One drill is untwisted and the end is forged flat, after which the sides of the flattened portion are bent upward at about 90 degrees to form a trough shape slightly rounded on the inside bottom surface. This job is best done by using as an anvil a piece of steel with one edge rounded to the radius you desire to produce on the wood. Next, the end or tip is bent upward at an angle of about 15 degrees, and a collar or washer

is brazed on the shank part of the tool to rest against the handle when the latter is driven in place. The tip or cutting end of the tool is now hardened by heating it to a bright cherry red and plunging it into cold water. Then the tip is polished bright, reheated carefully to a straw color and then quenched quickly in water. After grinding the tip on the underside to form the cutting edge, a wooden handle drilled to take the shank tightly is driven in place. On some jobs it may be necessary to grind off the tip corners to keep them from catching on the work.

—Walter E. Burton, Akron, Ohio.

High Partition in Toolbox Increases Its Carrying Capacity

Instead of hunting through his small toolbox whenever he wanted a certain tool, a carpenter substituted a high partition for the regular one, and fitted it with racks for saws and other most-used tools. This arrangement made selection of tools easy, increased the capacity of the box and provided a carrying handle that could be reached without stooping low.

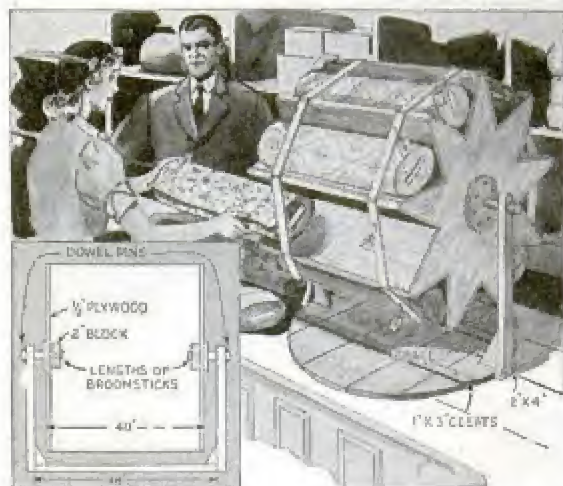
Reinforcing Bolted Wood Joints

A simple method of reinforcing bolted joints in wood framing is to insert a piece of metal lath or large mesh wire between the boards before bolting them together. The wires will sink into the surface of both pieces of wood, locking them together when the bolts are drawn up. A few hammer blows while tightening will help.

—Robert Hamilton, St. Joseph, Mo.

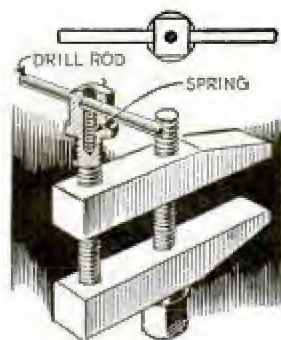


Ferris-Wheel Display on Counter Helps Customer Select Cloth



After installing this unusual counter display, one dry-goods merchant found that it not only pleased his customers by permitting them to select their purchases at their leisure, but it also saved time for the clerks by making it unnecessary for them to take down from the shelves several bolts of cloth to show each customer. The display can be made any size desired, although one 40 in. wide and 4 ft. high holds nine bolts of cloth which is about right for a counter. The sides are cut from $\frac{1}{2}$ -in. plywood and are pivoted to two supports by means of short lengths of broomstick. These turn in holes in the supports, and are a drive fit in holes in the side pieces, reinforcing blocks being used on the side pieces as indicated. The supports are screwed to a circular base and braced with corner blocks. Several boards glued together make up the base, which is reinforced with two horizontal cleats 1 in. thick and 3 in. wide.

Fitting Toolmakers' Clamps With Sliding Handles



Small toolmakers' clamps that are made for use with a wrench can be improved by fitting them with sliding handles. For the small $1\frac{1}{2}$ or 2-in. sizes, this is best done by drilling a small

hole about $\frac{1}{2}$ in. deep in the squared end of the clamp screw, and then drilling a second hole through the end at right angles to the first one to take a $1\frac{1}{2}$ -in. length of drill rod. In assembling the handle, first insert a small coil compression spring in the blind hole so that it bears against the rod when it is inserted. The spring holds the rod in any position desired. Peening the rod ends keeps it in place.

—W. E. Jacobson, Riverdale, Ill.

Strain of Standing at Machines Eased by Powder Puffs

To lessen the strain of standing at a production machine for long hours, one operator places a powder puff in the heel of each of his



work shoes. As the puffs come in a variety of sizes, it is usually a simple matter to find a couple in a ten-cent store that will suit.

—William Swallow, Brooklyn, N. Y.

Lathe Chuck Is Adjusted Quickly By Spiral Ratchet Screwdriver

Lathe operators will find that much time can be saved in adjusting a chuck by using a spiral ratchet screwdriver instead of the regular T-wrench. The wrench will have



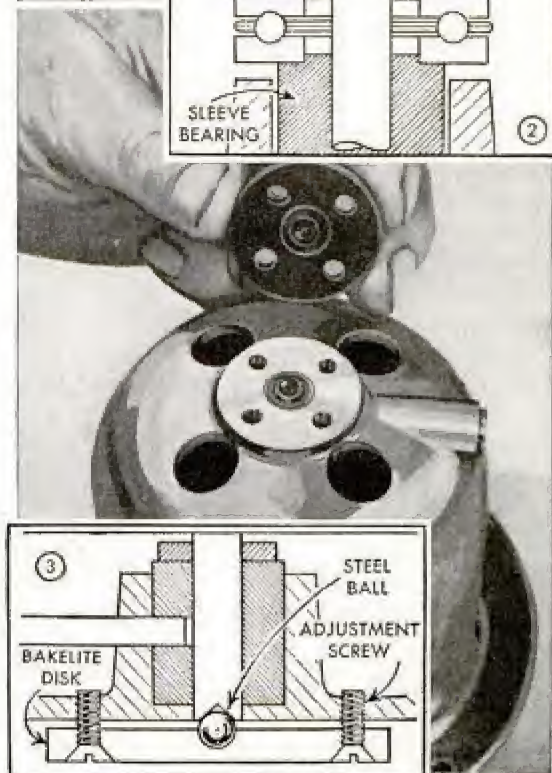
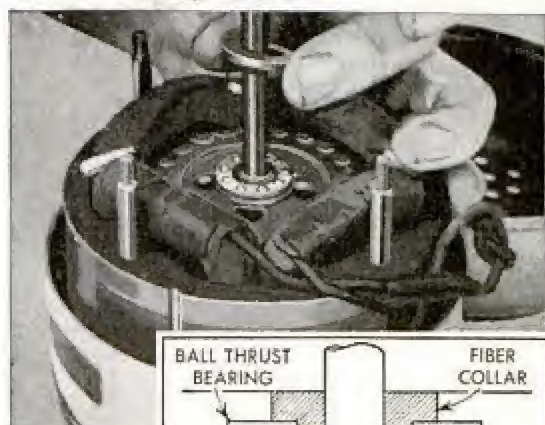
to be used in tightening the jaws after they come in contact with the work, but the screwdriver permits the jaws to be run down quickly to the work or backed away from it. A short piece of metal ground to fit the chuck-jaw sockets and substituted for the screwdriver blade will be handy.

Operating Horizontal Motor in Vertical Position

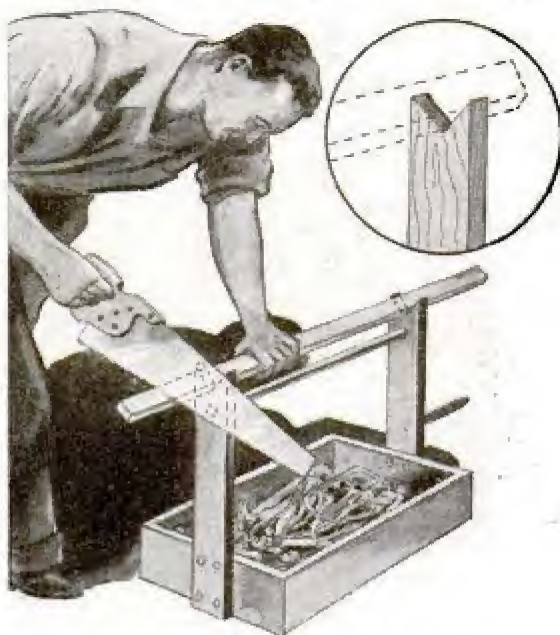
Almost any electric motor of fractional horsepower that is designed to operate in a horizontal position can be used in a vertical position if an adequate method of lubricating the bearings is provided and a thrust bearing is installed to keep the armature shaft from rubbing on the end-plates of the motor housing. The simplest method of lubricating the bearings is to install a grease tube as shown in Fig. 1. This consists of a suitable length of tubing, tapped at one end to take a screw plug, and filled with yarn or other packing. One end of the packing is held against the motor shaft by a small spring inside the tube. A special grease lubricant, such as comes in collapsible tubes for sewing machines, vacuum cleaners, etc., is used. Or, a mixture of finely flaked graphite and light petroleum jelly can be used.

To install the tube on very small motors having babbitt or thin bronze sleeve bearings that usually cannot be removed without damaging them, you enlarge the oil-hole to take the tube with a press fit. This is done by taking out the motor shaft and drilling through both the housing and the bearing. On the larger motors that are likely to have removable bronze bearings, you can remove them, enlarge the oilholes, and then insert the grease tube through the oil well in the housing.

After taking care of the lubricating problem, you are ready for a thrust bearing. On the smaller, single-end shaft type of motor, a steel bearing ball working in the countersunk center hole of the shaft end will suffice. This is shown in Fig. 3, the ball being retained in a shallow depression made in a Bakelite plate, which is held by screws tapped into the end plate of the motor. This arrangement permits tightening the screws to take up wear. The ball will eventually sink into the Bakelite to a depth that will necessitate replacing it. On larger motors having double-end shafts, regular ball thrust bearings will have to be installed. This can be done by turning a shoulder on the bearing, and then making up a shouldered fiber collar to fit between the bearing and the end of the armature as shown in Fig. 2. Usually, the cone type of bearing used on bicycle wheels, or the flat type used for lathe headstocks are small enough to fit into the space between the armature and the motor bearing.



This Tool Kit Serves as Sawhorse When Handling Small Work

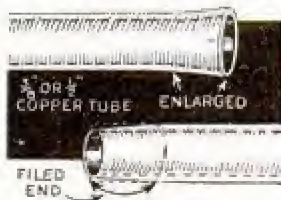


For small jobs away from the shop, one carpenter carries a tool kit like the one shown. The vertical members of the handle are notched at the upper ends to make a convenient sawhorse for cutting moldings and other small pieces.

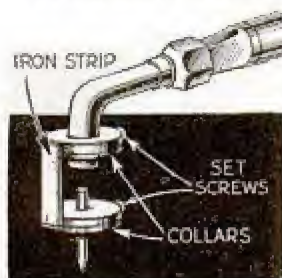
Copper Tubing Joined Securely

The next time you have to join some copper tubing and have no regular tools at hand for the job, try the following: Enlarge the end of one tube with a file or screwdriver, and file down one end of the other tube to slip inside it. Then, after tinning the surfaces that are to contact, you can sweat-solder the joint.

—Harold Rupp, Florence, Ariz.



Welding Torch Used to Solder



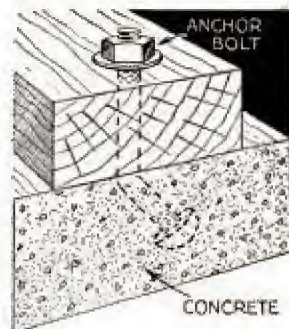
On a job of soldering several thousand floats, I used this simple attachment on a gas welding torch and did the job quickly. The attachment consist-

ed of two metal collars spaced with an iron strip to hold a piece of carbon so that the low flame of the torch was directed against the upper end of it as shown. This gave the desired heat at the lower end of the carbon so that the soldering could be done without discoloring the floats, which were made of brass.

—Marion L. Holsinger, Harrisonburg, Va.

W.T.M. Concrete Anchoring Bolts in Concrete To Prevent Turning

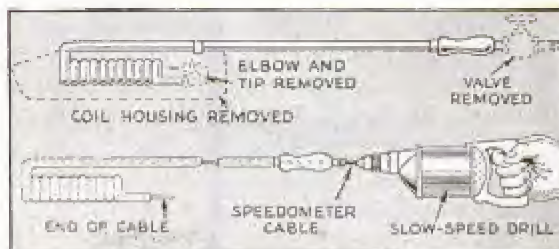
If bolts are anchored in concrete for the attachment of objects that must be removed and replaced at intervals, any tendency of the bolts to loosen because of these repeated operations can be avoided by bending the bolt as indicated. This idea is also handy when attaching objects that require the nuts to be drawn up exceptionally tight, as the bent bolts are anchored more firmly in the concrete than when straight bolts are used.



Coils of Weed Burner Cleaned With an Electric Drill

When the coils of a fire gun used for burning weeds became clogged with carbon, I cleaned them with a speedometer cable that was rotated inside the coils with a slow-speed electric drill. After removing the valve from one end of the coils and the elbow and tip from the other end, a speedometer cable was worked through them and one end chucked in the drill. Rotating the chain removed the carbon, after which kerosene was run through the coils to remove all loose particles of carbon. When reassembled, the fire gun worked as good as a new one.

—Blair Votaw, Phoenix, Ariz.



Check VISCOSITY

for Better Spray Finishing

WHEN using a spray gun, you probably have noticed that on one job the paint is applied just right for an even coat, while on the next job you may get runs, a sandy surface or excessive dusting. Chances are that the trouble is the viscosity of the paint or lacquer you are using. Viscosity indicates thick and thin liquids. For example, light, thin No. 10 automobile oil has a low

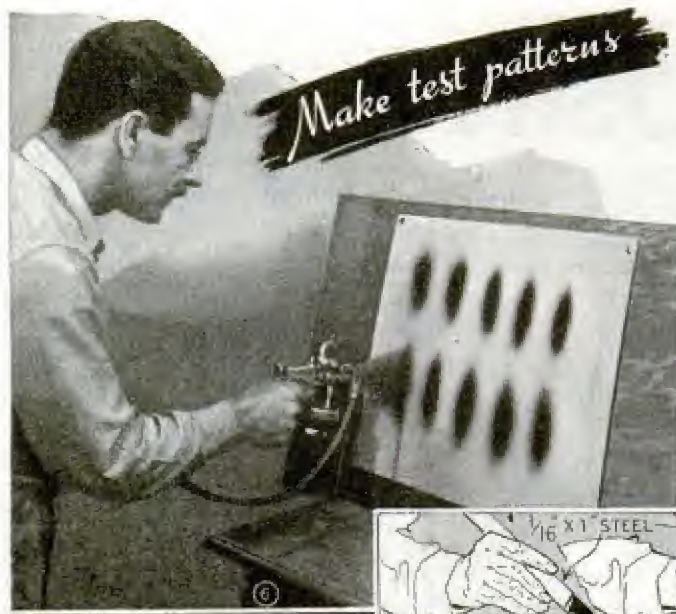


viscosity and the heavier and thicker No. 30 oil has a high viscosity. When using paint or lacquer of high viscosity in a spray gun, you get spatter and excessive orange peel; when the viscosity is too low, you get a thin, sandy finish, possible sags, and excessive dusting.

It is obvious that there is a right viscosity for every fluid and for every spray gun, and the trick is to get it just right when you spray. To do this, you need some device that will measure viscosity. A simple one is a glass tooth-brush tube or a test tube, at the bottom of which is drilled a $\frac{1}{16}$ -in. hole. Also, an opening is cut about $2\frac{3}{4}$ in. from the end, as shown in Fig. 2.

Both hole and opening may be cut in glass by using a silicon-carbide wheel mounted in a hand grinder. A guide mark is ground on the glass about $\frac{1}{2}$ in. from the end. To use, dip the tube in the fluid being checked so that the tube is filled to the lower edge of the opening. Then quickly lift the tube and allow the fluid to run out through the bottom hole as in Fig. 1, carefully noting the time that it takes. If you are checking a clear fluid, take the time when the fluid drops to the mark on the lower end of tube; if you are checking opaque fluid, take the time the instant the stream breaks. Results obtained by such timing give comparative viscosity figures for various liquids.

Another simple check is the falling-ball

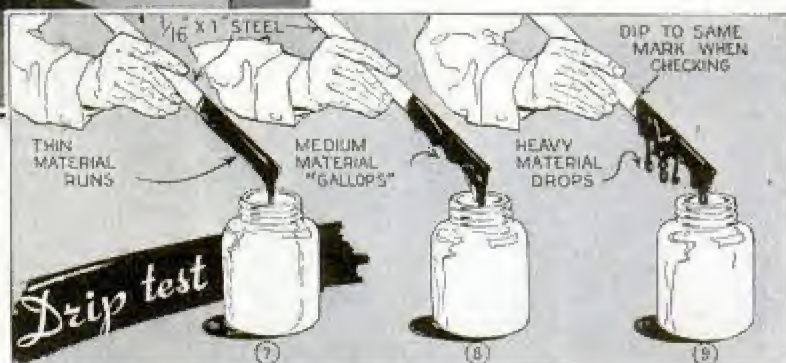


own gun and compressor, is a matter of checking with test patterns. Start out by filling the spray-gun jar about half full of a liquid, which you know is definitely too heavy, and spray a test pattern, as in Fig. 6. Then add a small amount of thinner and spray another test pattern. Continue in this way until you find the proper viscosity to use for your gun. Recheck by spraying a complete panel. Now, measure the viscosity of the most suitable fluid by any of the methods described. Fluids that are

method. You drop a small steel ball into the fluid and note the number of seconds required for it to hit the bottom of container as shown in Fig. 3. This is a handy way of checking if you use glass jars on your spray gun, as the ball or balls can be left in the jars. If you have a small compressor capable of spraying only light fluids, it will be necessary to use glass or plastic balls instead of steel ones. Obviously, the greater the drop, the more accurate the test; 5 in. is a good distance, but 10 in. is the professional standard. It will be apparent that this test cannot be used with opaque materials.

Still another method is the use of viscosity tubes, as shown in Figs. 4 and 5. Standard viscosity tubes are quite inexpensive (about ten cents each), but small vials of uniform size can be used. You will need six or seven. Each one is filled with the fluid being checked so that there will be an open space of about $\frac{1}{16}$ in. below the cork. When the tube is inverted so that the open air space becomes a bubble, it will travel to the upper end of the tube. The time required varies with the viscosity. The exact size of the bubble is not important, but the tubes must be the same inside diameter for good results. If the bubble travels too fast when checking thin fluids, the tube should be set at an angle instead of being turned upside down.

To correlate results obtained by any of these methods with the capacity of your



used in the spray gun should be brought to the same viscosity as that of the original test fluid. If you use the viscosity-tube method, seal a tube containing the "just-right" fluid, and use this tube for direct comparison.

Making these tests takes a little time, but it is well worth the effort. Just remember how long it took you to wash and sand off that last job you spoiled. However, if you persist in sticking to the crude paddle test, at least make a point of testing in a uniform manner. Use a piece of metal $\frac{1}{16}$ by 1 in., and always dip it into the liquid to a predetermined mark. Liquid that is too thin will immediately run off the end of the paddle, as shown in Fig. 7. A liquid that is too heavy will drop before it runs, as in Fig. 9. Liquid that is close to the right viscosity starts to run but has enough fluidity to finally flow to the end of the paddle in more or less wavy "gallops," as in Fig. 8. Sprayers get good results with this method, but in all cases the viscosity tests already explained permit greater accuracy.

☛ To do a good job of filling wood grain, use the heel of your hand in a circular motion to further pack the paste in the pores before wiping off with a cloth.



Radio

First Aid Hints for Home Sets

MOST "chairside" receivers present a mechanical problem to the average set owner when it becomes necessary to replace tubes, as the chassis base must be removed from the cabinet.

If your set is a phono-radio model, similar to the one shown in photo (A), and you are not familiar with the compact internal arrangement, it is best to leave tube replacements to a radio serviceman. On the other hand, if you have changed tubes in various types of sets, and your "chairside" receiver is one of the models without a record player, remove the line cord plug from the wall outlet first, then disconnect the antenna and ground leads.

Where the controls are on the side, the cabinet may be turned upside-down as illustrated in photo (B); in this assembly the chassis and speaker were all mounted on a sliding side panel that was easily removed. If the chassis

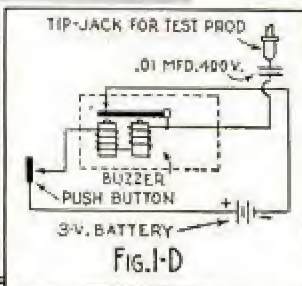
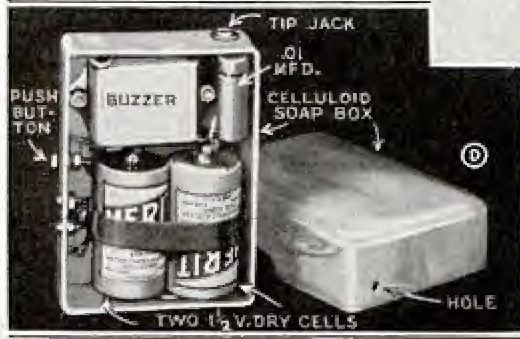
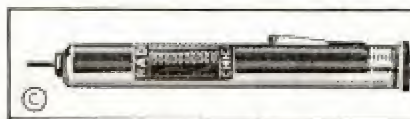


screws up, and place a book or block inside the cabinet under the top of the chassis so that it will not drop when the mounting screws are removed. The dial proper is usually a part of the chassis assembly.

A high-frequency "test buzzer" signal generator is a handy and efficient test unit for the radio student and experienced set owner. Battery operated, it generates both r.f.

and a.f. signals and provides a rapid method for determining what particular stage of a receiver is defective. A compact type appears in photo (C), and a homemade unit is shown in photo (D) and circuit diagram Fig. 1-D.

The short test prod of the signal generator is held close to the antenna to adjust trimmer condensers on t.r.f. sets; and grid of 1st detector tube in supers.



is screwed flat to one side of the cabinet, and the separately mounted speaker has a plug and cable arrangement, lay the cabinet on its side with the chassis-mounting

UNIVERSAL TESTING BRIDGE

By L. M. Dezettel



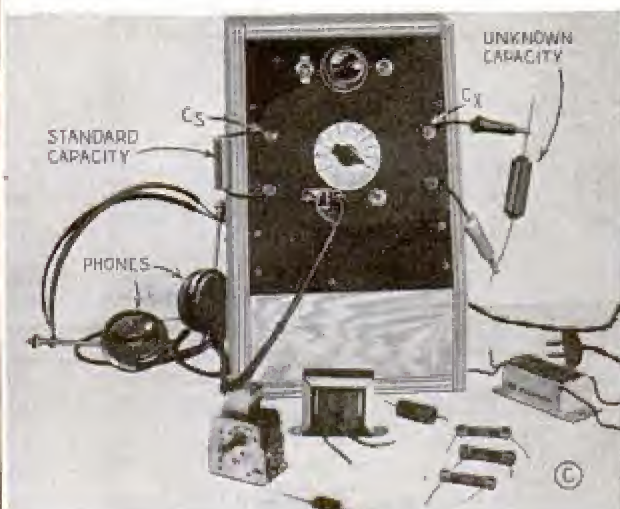
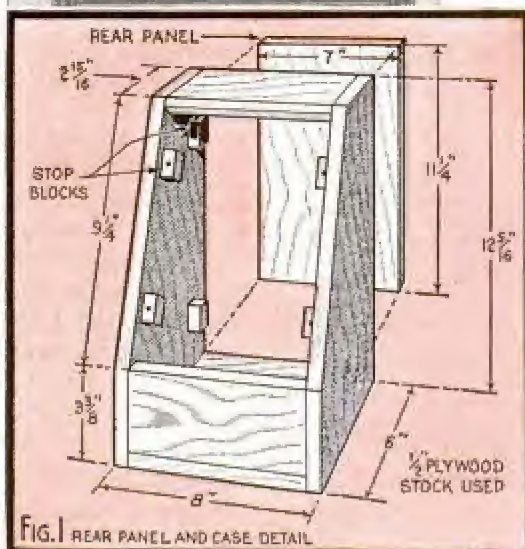
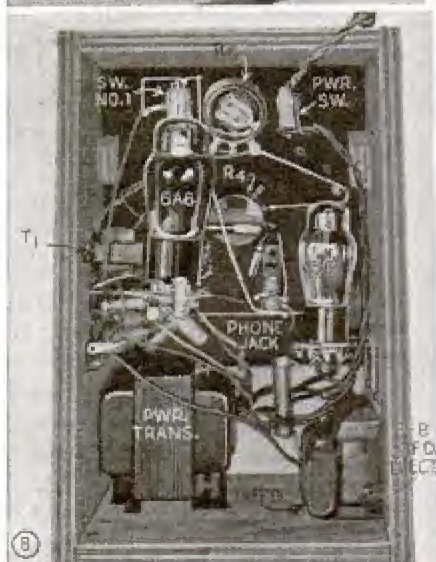
A SSEMBLED from standard radio parts that nearly every experimenter and serviceman has on hand, this test unit is capable of measuring resistors, condensers and chokes without the use of a meter. Identify, and put old parts to work in servicing home receivers and building useful emergency sets, student receivers, amplifiers and similar units.

It is based on the simple and widely known bridge circuit in which an unknown resistor, condenser or choke is measured as a ratio of a known resistor, condenser or choke. This ratio depends upon the ratio between two resistors within the instrument. The case is made of plywood, all dimensions of which are given in Fig. 1; the front panel may be of $\frac{1}{8}$ -in. Bakelite, hard-pressed wood or any similar material.

Photos A, B and E show front and rear views of the completed unit. The same general arrangement is illustrated in the simplified wiring diagram that appears in Fig. 2 in which all parts are shown in their relative positions on the rear of the front panel and as mounted on the inside of the case. A large round-hole lug is placed under the mounting nut of switch No. 1 for an added common ground connection.

The circuit consists of a bridge network, with variable resistors R_4 and R_5 , a constant tone source, and a pair of headphones. The tone is heard in the headphones and the resistors are balanced until no tone signal is heard. The value of the unknown resistor, etc., is then read on a calibrated scale. Since requirements of the power supply and oscillator are not critical, almost any tube combination can be used. In this case a type-56 tube is employed as a half-wave rectifier. Select several resistors, condensers and chokes of known values to act as your standards.

Practically any old power transformer can

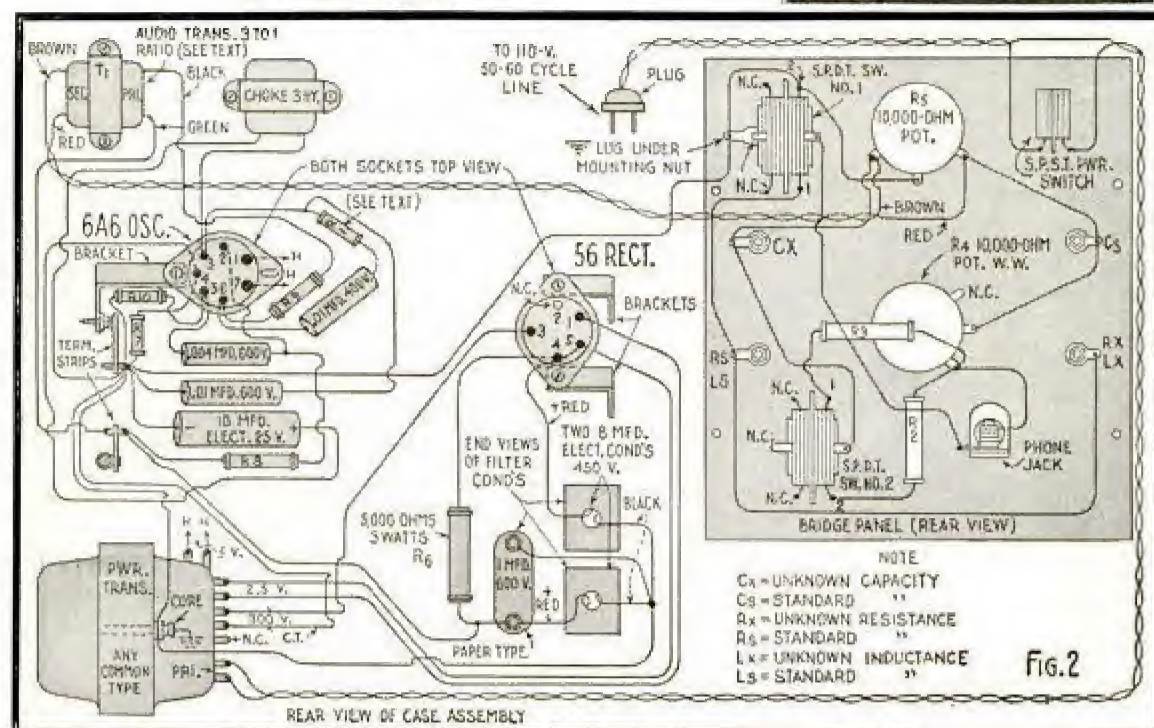
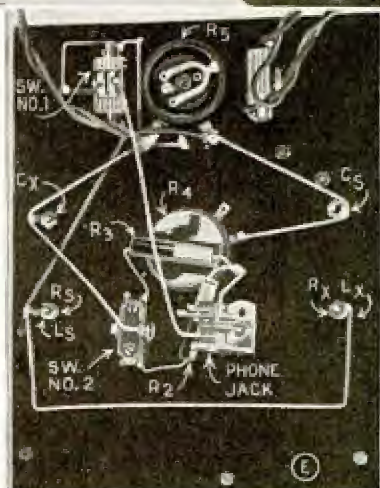


MEASURES UNMARKED PARTS

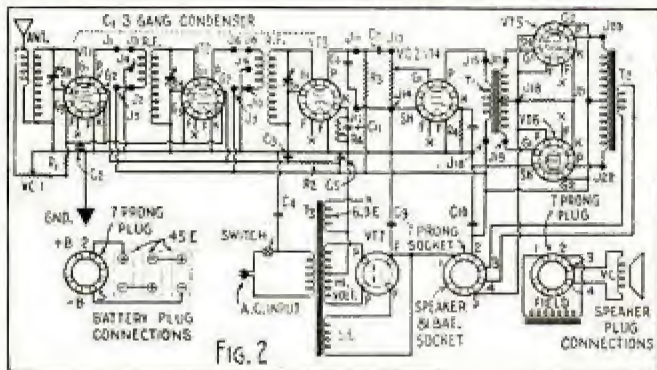
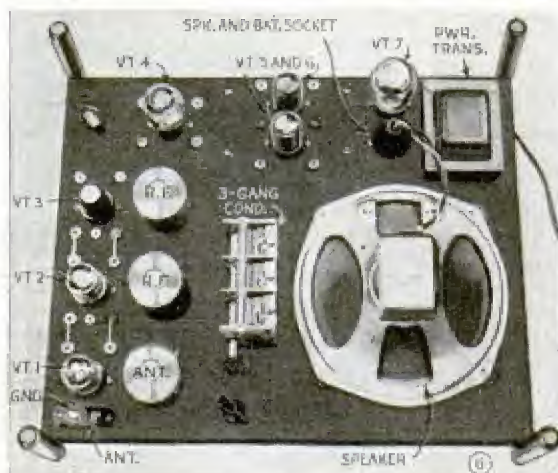
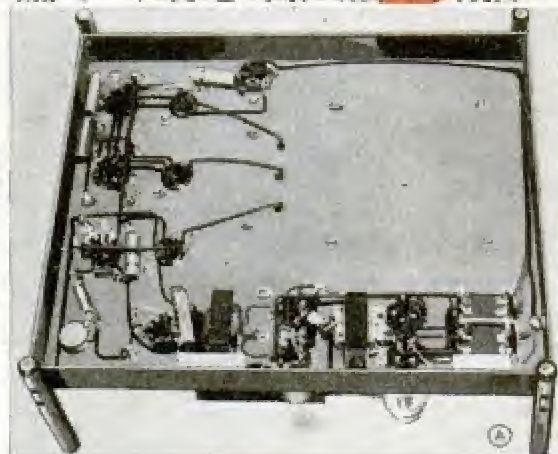
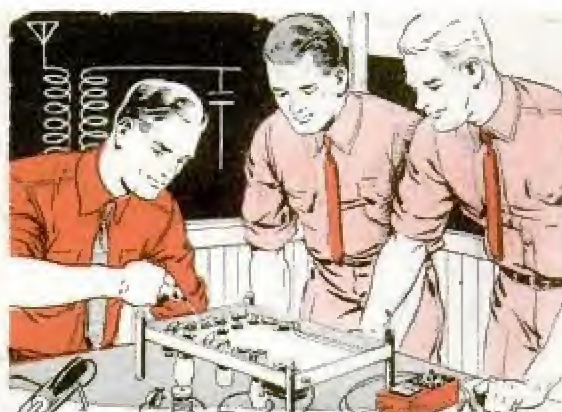
be used, as only about 50 volts are required for the oscillator. The transformer in this case was a common broadcast set variety with a 600-volt secondary high-voltage winding. Only one-half the high voltage secondary was used, the other high voltage end being clipped off. To further reduce the voltage, a 5,000-ohm 3-watt carbon resistor was used and also served for filtering. A 6A6 tube is used for the oscillator. This is a 6.3-volt tube but may be operated from the 5-volt winding, as the oscillator is not called upon to deliver much power.

The fed-back energy should be as little as possible and still be enough to maintain oscillation. The value of resistor R_1 should be experimented with to obtain this result. The output is fed to the bridge circuit through an ordinary 3-1 ratio audio transformer connected in reverse. Resistors R_2 and R_3 are $\frac{1}{4}$ -watt carbon types with a 2 percent tolerance, and potentiometer R_4 is a wire-wound unit. The headphones should be high impedance type; crystal if you have them. To measure a resistor, using a standard resistor of 1,000 ohms, connect the standard to terminals R_s and the unknown resistor to R_x . A tone will be heard in the headphones; switch No. 1 should be in the No. 1 position, and potentiometer R_4 rotated until no signal is heard in the phones on one

(Continued to page 170)



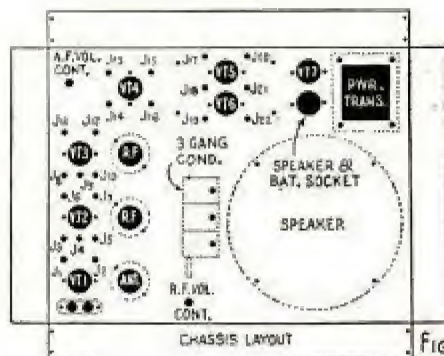
Classroom Demonstrator for Radio Training



DESIGNED to provide an exceptionally flexible operating model of an a.c. receiver for schools training Army, Navy, aircraft and civilian radio students, this 7-tube demonstrator can be assembled, tested and dismantled at will. The tuned-radio-frequency circuit may be wired in stages so that the students can test and operate each stage individually, or in combinations, from the self-contained power supply or external batteries. The complete assembly with push-pull audio output stage provides ample volume and good quality for practical demonstrations.

The chassis layout and schematic circuit diagrams are given in Figs. 1 and 2. Four dowel rod rests are used, one on each corner of this kit chassis, to facilitate handling. By means of this handy arrangement the receiver can be placed on any of its six sides without damage to the parts or the table, desk or bench on which it is placed. This feature is illustrated in photos A and B. The metal chassis is 13 in. wide, 17 in. long and 1 3/4 in. high.

Combinations of pin jacks and jumper wires are used on top of the chassis in order to operate the set in stages. These pin jacks also provide a means for making electrical measurements at practically all parts of the circuit. The 8-in. dynamic speaker is mounted on 4 dowel rods that support it above the base at a height of about 2 inches, and is connected in the circuit by means of a short cable and a plug that fits into a socket on the base. Both a.f. and r.f. volume controls are provided, and nothing has been overlooked that would be helpful to the student and the instructor. The tube line-up is as follows: two 6SK7-GT's; one 6C5-GT; one 6L5G; two 6V6-GT's as output tubes, and a type-80 full-wave rectifier.



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"Gran'maw—c'mere—the Army wants ter know if Willy is six feet tall!"

THIS YEAR ALL AMERICA MUST MEASURE UP

Today we must all measure up in our war effort. Even in little things like keeping our cars up to snuff—so they stretch every rationed gallon of gasoline miles farther.

That's the job Auto-Lite Spark Plug Dealers can help you do with "Plug-Chek" Inspection Service. Actual tests by the American Automobile Association show this new spark plug service can help increase gas mileage as much as 12%.

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Keep 'em Smiling!

... and help the U. S. O.

A big, new 24-page book of Paul Webb's "Mountain Boys" cartoons mailed by us to men in service. Send name and address with dime or War Savings Stamp which we will turn over to the U. S. O. in full.



First Aid for Guns and Tackle

(Continued from page 69)

mainly because they don't know how easy it is. I put up two deer last fall in Mason-type jars and the meat is in my cupboard now, tenderly cooked and ready to eat. A couple of weeks ago when I got back from a deep sea fishing trip I put up 48 pounds of tuna in glass jars. If you follow the directions that come with a case of jars you won't go wrong. Use the dry, hot oven process, cooking fish five hours at 250 degrees and meat two hours at 250 degrees. Tough deer shank makes good mince meat if you cut it up, add suet and raisins, then can it. You may add apples and other ingredients when you open the jar.

Keep your ammunition, rubber boots, and other rubber goods in a cool, dark, dry

place. Your tennis racket will last longer if you keep it in a press and shellac its strings lightly with white shellac now and then. Skis keep their shape best when tied against a spreader, with clamps to keep the toes bent out. When winter is over I scrape all the varnish off my skis, right down to the wood, then smooth them with steel wool. Let them lie unpainted all summer so that they lose all their moisture, then revarnish them in the fall. Never use a boot oil to preserve leather goods. That makes them heavy. Leather should be dressed with saddle soap.

Remember, you won't get much more sports equipment until the war is over, so take care of what you have right now.

The Mystery of the Common Cold

(Continued from page 37)

search unit was organized in 1934 by Commander Albert P. Krueger and has been on active duty since January of 1941. It is an integral part of the 12th Naval District medical activities under Captain E. U. Reed.

Aside from developing effective vaccines, the unit is studying means of controlling the air-borne infection. Work is being done on chemical agents that inactivate the virus in the air without harming it. Studies at the University of Chicago's Billings Hospital indicate propylene glycol vapor is one such agent. This cheap, odorless, tasteless, non-toxic substance in the future may be sprayed into the air in theaters and schools. One part of glycol in 2,000,000 parts of air is said to kill heavy concentrations of suspended bacteria in a few seconds. As is the case with common colds, one of the dangers of influenza is its wearing down of resistance to a point where other infections can take hold. Pneumonia has been a frequent and deadly secondary infection. The new sulfa drugs, which have no effect on influenza virus, are such a potent weapon against pneumonia that the pneumonia death rate last year was less than half as high as was its average during the 10 years ended in 1937.

With their improved understanding of respiratory upsets and infections, have medical authorities any new advice for treating colds? Unfortunately, there is no

specific cure—all information. They advise you to avoid abrupt changes of temperature and humidity as much as you can. That is, the nose should be given a chance to adjust itself to the new conditions when, for instance, you leave a dry warm room and go outside into a cold and moist atmosphere. Next, avoid overcooling or excessive heat loss, such as resting in a draft after exercise, or continuing to wear wet clothing. Third, keep up your resistance by avoiding fatigue, improper diet, and overindulgence, and by proper exercise.

When you do catch cold in spite of these precautions, warmth and rest are the best things for you. Staying in bed a few days helps avoid a more serious secondary infection. There are numerous preparations at the drugstore that may give some comfort, though no one preparation seems good enough for universal recommendation. Ephedrine preparations that help shrink the nasal passages give some relief. Oily substances may prove harmful. Hot baths and hot drinks also give relief provided you stay in bed to avoid a chill. Never "stuff a cold." You are better off by taking nothing but plenty of liquids for the first day or two. Most important—stay in bed if you can, and in all events, get plenty of rest and keep the room warm and moist. In fact, the more you take it easy, the easier the cold will be on you.



More fire power to 'em!

Our fighting men are showing the world the stuff of which America is made.

It's our job to back them with arms worthy of their skill and courage. So, for over a year, huge quantities of Savage-built Browning aircraft machine guns, Thompson submachine guns, and military rifles have moved in a steady stream to our forces on world-wide battle fronts. We're glad that the arms experience and

technical skills in our organization made it possible to get large quantities of military equipment into production quickly. Savage Arms Corporation, Utica, N. Y.



It was because of high achievement in production of War equipment that the Army-Navy Production Award was bestowed on the Utica Plant of the Savage Arms Corporation,

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"Hammerless," streamlined — this famous rifle has been the dependable companion of big game hunters the world over. After Victory, it will continue to be the ideal, high-power hunting rifle.

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SUPERIOR DROP-FORGED TOOLS

Shakedown Cruise

(Continued from page 79)

the steam lines are blown out, generators started up, and the main engine is turned over. All the steam-operated equipment is tested and adjusted. Then the long steaming trial begins in the dock. Meanwhile the Maritime Commission experts are testing her fuel consumption, her horsepower, and are checking the operation of all the engine room department equipment. Hundreds of ships like this one have been built already, but nothing can be taken for granted.

Next to come on board is the company's port captain with his crew of deck officers and men, together with more inspectors. The ship goes out on her harbor trials, testing for speed, maneuverability, and her ability to stand the strains of unusual maneuvering. For passengers she carries the deck and engineering officers who will operate the ship at sea. These men are already familiarizing themselves with the vessel and the way she handles.

The trial board is not the only agency that looks the new ship over. The American Bureau of Shipping has put men on board to determine that the hull is sound and the machinery safe and seaworthy. Men from the Bureau of Marine Inspection and Navigation try out the boilers, set and seal the safety valves, and test such safety devices as the life boats and rafts, the fire fighting equipment, and the navigation equipment. Representatives of the Public Health Service test out the drinking water and sanitary systems. One of the last inspections is made by the "rat man" of the Public Health Service, who goes over the whole ship looking for places where rats might be able to hide and build nests. Every such space must be accessible for inspection and easy cleaning.

American shipyards have attained their goal of three ships per day. Before the end of 1943, more than 1,600 Liberty ships alone will have been launched, aside from other vessels that are being constructed. This vast fleet is being built for the sole purpose of helping to win the war, but its usefulness will not end when the war is over. These ships are sturdy and economical. Decades after peace is signed they will be carrying the American flag along the trade routes of the world.



Announces

A NEW, NATION-WIDE CONSERVATION SERVICE

TO MAKE this new service available quickly, AC has placed trained men in the field to carry to all service organizations the latest and best methods of diagnosing trouble, testing, adjusting, and repairing AC products with a minimum of parts replacement. This will help to conserve material and shorten the time required for repairs.

For Your Car or Truck

Your car or truck is equipped with from one to nine of these AC devices. All are *important* to the conservation of your gasoline, oil, and tires. Some of them are so indispensable that, if they fail, you cannot drive at all.

For Yourself—and America

A list of the products covered by this new, wartime service; and a brief statement of what they require, and why; are given at the right of this page. For your own good, and for the conservation of America's gas, oil and tires, follow the suggestions given.

AC SPARK PLUG DIVISION—GENERAL MOTORS CORPORATION



SPARK PLUGS—Dirty or worn plugs waste up to 10% on gas. They also cause hard starting, weaken your battery. Have your plugs cleaned and adjusted every few months.



AIR CLEANERS—A dirty air cleaner restricts the flow of air into the carburetor, reduces gasoline economy. Have your air cleaner rinsed every time your car is lubricated.



FUEL PUMPS—Practically trouble free. However, if yours has been in use thirty or forty thousand miles, a check-up is probably due.



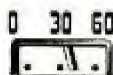
OIL FILTERS—Slow driving accelerates formation of soot and carbon in engine oil. This dirt will clog piston rings, cause increased consumption of oil and gas. Replace your oil filter element when AC Test Pad shows oil is dirty.



SPEEDOMETERS—Speedometers are very reliable, seldom give trouble. Keep them in good condition.



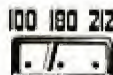
AMMETERS—Very reliable, seldom require service. Must be kept in good condition because they show whether the battery is being charged or drained.



OIL PRESSURE GAUGES—If they stop functioning, SWITCH OFF THE ENGINE, call a competent service man at once. Usually, the trouble is in the oil supply system.



GASOLINE GAUGES need to be kept in reliable condition, although they seldom need service.



TEMPERATURE GAUGES—your only indicators of engine heat. Although very reliable, they should be kept in condition.

LIGHTER MOMENTS

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"It's your wife, sir, she says to be sure and wear your ear muffs and rubbers."



One of the important uses of "Eveready" "Mini-Max" portable radio batteries by our armed forces is to furnish power for "walkie-talkies" (portable 2-way field radios). Because the armed forces are taking all we can make, there are none available for civilians.



The words "Eveready" and "Mini-Max" are registered trade-marks of National Carbon Company, Inc.

Movie Make Believe—Made To Order

(Continued from page 92)

The construction department transformed an old balloon hangar into a church, borrowed an old shack from "Lady in a Jam," salvaged a number of beams from "All Quiet on the Western Front," arches from "Tower of London," and stairways from "Eagle Squadron" and put them all together to create a Chinese mission.

Another department that helps in creating a set is the library of photographs and paintings that depict scenes in all parts of the world. Such a scene is enlarged to 16 by 20 feet and used as a background behind an open window.

Nowhere except at a studio, possibly, would you enjoy a breakfast that consists of a bowl of snow that has been sprinkled with broken glass and topped off with shaving lather. Such a dish is better than it seems, because motion picture snow consists of unbleached corn flakes. The broken glass is used for sweetening, for motion picture glass used for "breakaway" window panes and wine glasses is nothing but clear sugar candy. Even the shaving cream is palatable, being pure whipped cream that stands up better in pictures.

You would be disappointed if you tried a dish of motion picture ice cream. Real ice cream would melt too fast under the hot lights, so mashed potatoes are used instead. Likewise, cuts of meat such as lamb chops lose their fresh appearance during long rehearsals, so the lamb chop that you watch an actor eat on the screen may really be made of colored candy.

These are only a few of the substitutes that motion picture technicians have found to be better for picture purposes than the real articles. They use their ingenuity to provide practically anything that an imaginative script writer can demand. Sometimes the simplest ideas are best. At one studio some time ago thousands of dollars were spent in building a motion picture boat and in mounting it on rockers to create the effect of rolling in the waves. But the rockers were noisy and squeaked so loudly that the microphone picked up the sound in spite of several attempts to silence them with grease. The cameraman solved that one. He simply rocked his camera back and forth.

\$1,000 FOR YOUR IDEAS In the Big Marlin Gun Contest!

Now here's a chance for you hunters and target shooting fans, to *cash in* on your knowledge of guns! Marlin—always on the lookout for new ideas to improve sporting firearms—wants to hear from you. Sportsmen and gun dealers are cordially invited to join Marlin's big Gun Contest—with \$1,000 in cash prizes to shoot at. And remember, many a good idea is simple and easy to describe. Your chance is as good as the next fellow's to win a prize. It's easy to get in the contest—read the details below and send your entry in today! Contest ends July 1, 1943.

Jot down your ideas for improving any current model Marlin Gun. Follow the simple contest rules and send your entry in. If you wish, you may suggest new features, not at present in the line. A free catalog is yours for the asking, to review the features of Marlin Guns.

PRIZES IN THE BIG MARLIN CONTEST

The first prize is \$500.00 in cash; second prize \$100; third prize \$50.00; fourteen additional prizes of \$25.00 cash each. Seventeen prizes in all! (Marlin suggests the purchase of U.S. Savings Bonds with the prize money.)

JUDGING

Three famous gun editors—Bob Nichols of Field & Stream, Jack O'Connor of Outdoor Life, Maj. Chas. Askins of Sports Afield—will select the winning entries. All ideas for which prizes are given become the property of The Marlin Firearms Company and none will be returned. Prizes awarded for the seventeen ideas which are most valuable and practical, in the opinion of the judges. Duplicate prizes awarded in the event of a tie. WINNERS will be determined and prizes announced as soon as possible.

CONTEST RULES

The Marlin Gun Contest is open to all sportsmen and dealers in guns, with the exception of Marlin employees. Written suggestions must not exceed 300 words, the shorter the better. No limit to number of entries which may be submitted. Write name and address clearly on each suggestion. Mail entries to Dept. C, The Marlin Firearms Co., 17 E. 42nd St., New York City.

Entries must be received on or before July 1, 1943.

Win cash with your ideas! Enter the Marlin Contest today.

The Marlin Firearms plant is now 100% on war production.



Marlin's Over & Under Shotgun, in 12, 16 and 20 gauges and .410 bore, is hammerless, cocks on opening, has sturdy one-piece frame.



All Marlin rifles—lever action, clip and tubular magazine and .22 automatic, feature deep-cut, accurate, "Ballard" rifling.



Marlin lever action rifles, in calibers .22, .30, .30 and .32 spec., have the solid-top, case-hardened receiver, with safe side ejection.



It lost a war!

"For the want of a nail . . ." the shoe, horse, rider, battle—and, consequently, the whole war—were lost. So goes the schoolbook legend whose moral points to the importance of little things in the achievement of big things.

It takes *millions* of details to arm a war-winning nation. Every industrial job has them. Where filing operations are concerned, production heads, shop foremen and mechanics can accomplish much through the proper *use, care and selection* of files. Each of these phases has a bearing on:

Saving time in production or repair work;

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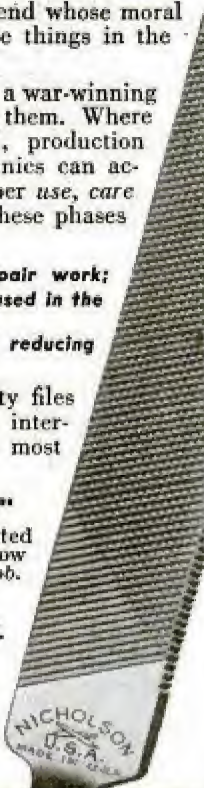
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A Backyard Flock Will Solve Your Meat Problem

(Continued from page 43)

below this, on which newspapers should be spread to catch the droppings. The papers should be renewed daily. For the first several days, however, roofing paper should be spread over the wire mesh floor to retain the interior heat. For the first several weeks, the wire mesh floor of the open runway should also be covered with a ½-inch mesh screen. The slanting roof of the brooder, weather tight, is hinged so that it may be opened for inspection.

Chicks must be kept dry and warm, at just the right temperatures. The best way to provide heat is with an electric heater, attraction light, and thermostat, mounted from the roof of the brooder. Good units cost \$5.00 and up and are still available at most feed and supply stores. An electric light is another constant source of heat but the air temperatures around it must be carefully guarded. Such a light should be enclosed in a large tin can suspended from the roof of the brooder. Punch a few small holes around the diameter of the can, at the bottom, to provide a small amount of light inside the brooder. If you are raising only a few chicks it is possible to keep them warm with a cloth-wrapped earthenware jug kept full of hot water.

For baby chicks, the air temperature inside the brooder the first day should be from 90 to 95 degrees, to be reduced one degree a day for five to six weeks, depending on the weather. Then no heat is needed. The chicks will chill if the brooder gets too cool; they will literally cook if the temperature climbs above the recommended point. To be safe you should operate the brooder for several days before you obtain the chicks, watching inside temperatures closely. Drinking water in the brooder must be kept tepid for the first few weeks. A cloth drape across the entrance to the outside runway allows the chicks to go outside during the day yet holds the heat inside the brooder.

After the chicks are two months old the brooder may be replaced with the shelter house. The pullets won't start laying until they are about six months old, but in the meantime the cockerels will provide many delicious meals of fried chicken.

The Navy's Fighting "Seabees"

(Continued from page 31)

boxing rings and bowling alleys, movies and music from the battalion's own band, provide recreation.

Permanent buildings are nearly completed, and machinery commences moving onto the transports.

One night just as the bugle is blowing the last notes of "Taps," Jack the Carpenter's Mate rolls over on his bunk and addresses his buddy Olson, Shipfitter, First Class.

"Olson," he whispers, "it won't be long to shoving-off time, will it?"

"No," grunts Olson, half asleep. "It's getting pretty comfortable around here now, and it sure is quiet!"

Olson is right, for some hundreds of miles away the Marines have landed at another beach, and are mopping up. A base will be needed, and soon the Seabees will land and construction will be well in hand.

Set 'Er Down in Your Back Yard

(Continued from page 31)

When Mr. Sikorsky established a world's endurance record of 1 hour, 32 minutes and 26.1 seconds in the air on May 6, 1941, the VS-300 was an ungainly skeleton with four fans: a three-bladed main rotor mounted on its complex control tower aft of the pilot, who sat on the nose in quite as exposed a position as the Wright Brothers in their kite of 1905; two smaller horizontal rotors on opposite ends of outrigger structures jutting sidewise from the tail, and a vertical tail rotor with sidewise thrust for turning and torque compensation. The outrigger blades turned in opposite directions and provided lateral (sideways) and longitudinal (fore-and-aft) control.

In the next major stage the outrigger bridgework was shorn off and a tower installed over the tail with a single rotor. This was still crude and clumsy, and on the theory that the simplest structure works best the tower was scrapped after extensive and satisfactory experimentation. The VS-300 had reached substantially its present form. The cockpit was later covered with fabric, and a vertical fabric fin from midsection to tail improved stability. Surviving the innumerable changes are the

(Continued to page 163)



IN war or peace, Indian motorcycling builds character and manhood...brings together, in the healthy comradeship of clean, wholesome sport, husky, red-blooded youngsters eager for action and adventure. Today, Indian riders are in the thick of things on all the world's fighting fronts...carrying out their missions brilliantly on motorcycles unsurpassed in power, stamina and safety.

After the war, new thousands will thrill to the sport of motorcycling...and Indian will have new and greater machines to give every rider *motorcycling at its best*...machines that only Indian could build.

In the meantime, see your Indian dealer. He can't sell you a new motorcycle, but he may have a swell reconditioned "buy"...and he's the man to see for service on your present machine.

INDIAN MOTORCYCLE COMPANY, SPRINGFIELD, MASS.



**BUY WAR BONDS NOW
★ ★ TO BUY AN INDIAN LATER ★ ★**



Serving a Fighting America Everywhere ★★★

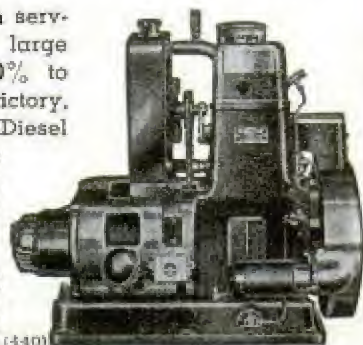


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★ WITTE Diesel Engines and Die-selectric Plants are aiding our gal-lant fighting forces in many parts of the world . . . in Alaska, in Africa, in the Panama Canal Zone, out in the South Pacific area and many other places where depend-able auxiliary light and a vital wa-ter supply may be needed.

For 73 years WITTE has been serv-ing the world. Today, the large WITTE plant is devoted 100% to war production. After victory, WITTE will continue to build Diesel Engines and Dieselectric Plants that are outstanding for efficiency and economical operation.

WITTE ENGINE WORKS 1744 OAKLAND AVENUE
LARGEST BUILDER OF SMALL DIESELS (4-40) KANSAS CITY, MISSOURI



BUILD THE BIGGEST \$1.00 PLANE IN U.S.

New, Redesigned 7-Ft. Super CONDOR Soaring Glider

Stronger, longer flights, more graceful lines, construction simplified. **\$1.00**
Easier than ever to build. Soars for hours. Kit VE-5019.....

4-Ft. Cleveland Eaglet

Unusually good model of a secondary type glider. Patterned after "Baby Howler". Easily built. **50c**
Kit VE-5018, only.....



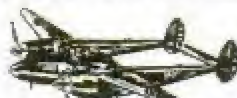
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192 pages of Arc Welding Lessons This one section is a gold-mine within itself. Shows student correct methods of present day applications. Brings the expert up-to-date. You can't afford to waste a day, so get your copy NOW!

HOBART Bros., Box M-431, Troy, Ohio
"One of the World's Largest Builders of Arc Welders"

main rotor consisting of three 14-foot blades turning 260 revolutions per minute in hovering flight, and a single 7-foot 8-inch tail propeller rotating in a vertical plane. The blades of the tail rotor, controlled by rudder pedals, vary from positive to negative in thrust for directional control, and with the pedals neutral there is a slight positive angle in the blades to compensate for the torque of the main lifting rotor. By pressing on either pedal the pilot can turn the helicopter right-about-face in its own length.

In the cyclic pitch control which is the brain of the main rotor lies the greatest investment of genius. Within the last year this has been perfected to the point that the rotor blades, at the command of the conventional stick, change their angle of incidence progressively as they revolve. With the stick forward, for example, each blade increases its pitch as it swings to the rear, is feathered at the sides and is at lowest pitch when it swings in front; the result is to tilt the craft's nose slightly downward for forward flight. With the stick back, the cycle of pitch is reversed and the helicopter goes into retreat. The helicopter engineer, instead of speaking of the wing angle of attack, refers to the inclination of the disc described by the rotor. Tilt the disc to the right and the craft moves in that direction. Similarly, the weight carried is described as disc loading rather than wing loading; that of the VS-300 is 2.25 pounds per square foot of disc.

The stick, operating the cyclic pitch control, determines the direction of flight. At the pilot's left hand is a second control lever which increases or decreases the thrust of the main rotor blades simultaneously to control the rate of ascent or descent. The throttle is synchronized with this to provide automatic change of power as the angle of the blades changes, so that revolutions per minute remain constant. These two levers and the rudders are the controls, simple in operation as they are ingenious and complex in conception.

Recently Mr. Sikorsky has been trying a two-blade main rotor, which would simplify storage. The helicopter still flies with one less blade, but there is more vibration. The difference is that between a 4-cylinder and a 2-cylinder car. It may work yet. The VS-300 with its pilot weighs 1,300 pounds.

(Continued to page 165)

Keep 'em Firing



BUY
WAR BONDS

Atlas

America's
Compact
Modern
LATHE



Top producers of weapons for land, sea, and air are the modern Atlas 10" Lathes. You'll find them throughout the nation in the tool rooms and shops of large and small armament makers. You'll find them frequently in mobile maintenance outfits of the armed services.

Atlas Lathes are selected for this vital work because they combine all modern lathe operating features and meet the high precision standards of industry *at lower cost*. New performance demands . . new materials to machine . . new techniques in development . . are contributing much to lathe advancement and assure you that the Atlas Lathe of tomorrow will be an even better one for you.

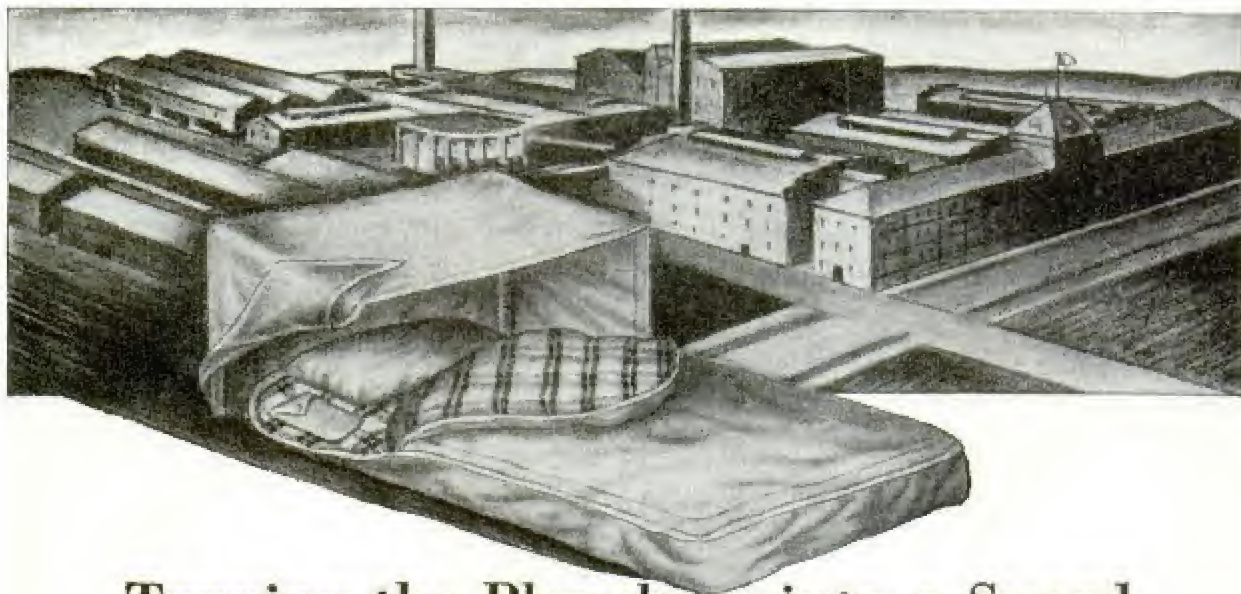
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443 North Pitcher Street
Kalamazoo • Michigan



VICTORY
FIRST!

-THEN Atlas
TOOLS FOR YOU



Turning the Plowshare into a Sword

Almost before the echo of cowardly Pearl Harbor bombs had died away, Ta-pat-co factories became an active unit of our nation's war industry.

Ta-pat-co sleeping bags, life preservers and other equipment dedicated to safety and comfort for lovers of outdoor sports in time of peace, now fulfill the same mission for our soldiers in time of war.

Ta-pat-co Sports equipment has become Ta-pat-co FIGHTING equipment—sleeping bags that give soldiers

warm beds in sub-zero temperatures—parkas that defy the cutting blasts of icy winds—life preservers that ride the crest of wave-tossed seas—on land, on sea and in the air—Ta-pat-co is in the war.

After victory is won, and the sword is beaten back into a plowshare, you will find your favorite Ta-pat-co equipment at your sporting goods dealer. Keep in touch with him. He will be the first to know when Ta-pat-co is again available for your outdoor sports enjoyment.

1-S-2

TA-PAT-CO Outdoor Sports Equipment
American Pad and Textile Company **FIGHTING** Greenfield, Ohio

Just You Two in Your Canoe



• THE rustle of leaves in a whispering breeze, with the light of a moon for your mood. An Old Town Canoe is a world of your own . . . your passage to peace and contentment.

The dip, dip, dip of a Redskin's paddle takes you through quiet enchantment. Paddling or resting, it's steady and strong. It's sturdy and easy to own.

FREE CATALOG shows all kinds of canoes for paddling, sailing or outboards. They're light in weight, perfectly balanced. Also outboard boats, Sailboats, Rowboats, Dinghies. Write today. Address Old Town Canoe Company, 934 Main Street, Old Town, Maine.

"Old Town Canoes"

Always write your name and full address clearly when answering advertisements.

U. S. MECHANIZED TROOPS RIDE WITH GUIDES



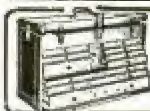
HULL STREAMLINE COMPASSES are used on U. S. Army motor vehicles to show direction of travel at all times. As Hull Streamline Auto Compasses have aided America's motorists in the past, so are Hull Compasses helping to guide our fighting men to their destinations today. Until victory, available for civilian purchase only so far as dealer stocks permit.

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P. O. Box 246-D4, WARREN, OHIO



Clean out car radiators thoroughly after draining anti-freeze. Use

Sani-Flush 10c and 25c sizes
Directions on can

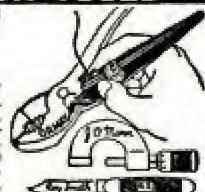


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Write with electricity any name or design on the hard-est and finest tools and instruments or any metal, like writing on paper with pen or pencil. Thousands used by mechanics, garages, machine shops. **Complete Outfit \$3.50—Prepaid Anywhere**. Interesting illustrated circular free. Write today. **ARKOGRAF PEN CO., 3927 S.E. Stark St., Portland, Ore.**



POPULAR MECHANICS

Mr. Sikorsky sees no reason why a helicopter of 10 tons gross weight, carrying 20 passengers and cargo, cannot be built. The VS-300 flies 70 to 80 miles an hour, 8 miles to the gallon with its 90-horsepower Franklin engine. They can improve those figures when they try.

Before this war is over the helicopter may be in it. It takes little imagination to see the helicopter as an ideal liaison craft, landing in a forest clearing or on a headquarters roof; or as an observation post hovering high above the ocean or battleground; or as an aerial machine-gun nest in lieu of barrage balloons. Rising vertically above a fort or factory it could meet enemy bombers halfway with a hail of bullets. The army tried an autogiro in mock battle against fighter planes and dive bombers some years ago, using cameras for guns. The autogiro got more photographic hits in its gunsights than either of its combatants. The dive bomber can't aim or evade; the pursuit plane is less accurate than the slower autogiro. The helicopter, which can sit still or dodge and keep firing, should out-perform the autogiro, which must keep flying forward for buoyancy.

After the war the helicopter surely will be the aerial runabout, climbing out of the back yard to fly to the grocery or the downtown office or the airport, settling gently into any space large enough to contain its structure. It is not designed for high-speed commercial air travel nor heavy cargo, but it should solve the problem of ferrying passengers from outlying airports into crowded cities.

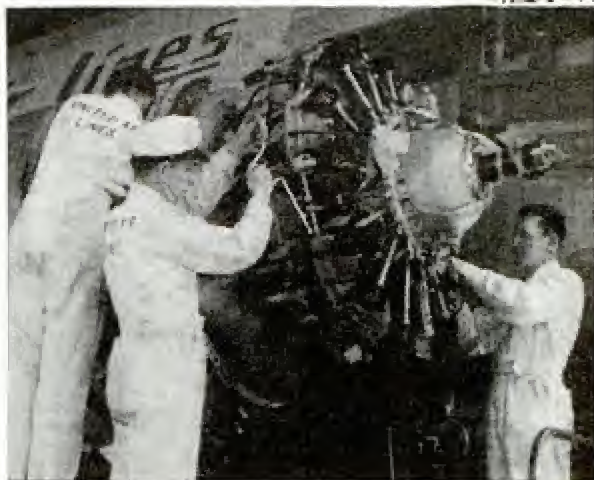
Fitted with rubber pontoons, the VS-300 is at home, like the Marines, on land—on the sea—and in the air. It lands on your concrete driveway so tenderly the pilot might hold a cup of coffee without spilling. It alights on a back yard pond with scarcely a ripple. In the Sikorsky yard they nose it up to a post and lift a ring off its top, hang it three feet above ground while someone loads a suitcase into a luggage rack on the nose, or poise upstairs while an assistant hooks a can of gasoline on a rope to be hauled up.

The airplane, says Mr. Sikorsky—and he builds them—in spite of its excellent speed and carrying efficiency, is a very helpless machine with respect to points of takeoff and arrival. The helicopter is the most independent creature man has devised.

"Snap-on tools have been a part of United Air Lines' Equipment, used in the overhaul of our planes, for the past 15 years."

W. P. Hoare

UNITED AIR LINES



For Maintenance and Overhaul UNITED AIR LINES Uses Snap-on Tools

250,000,000 miles of swift and efficient flight... such a record could be attained only through rigid standards of maintenance, highly trained personnel, and finest equipment. Snap-on tools have served United for fifteen years! "Continual endorsement of these tools by our personnel speaks for itself," says Mr. W. P. Hoare, General Superintendent, Overhaul and Repair Base.

Fine mechanics work with fine tools... and America's vast aviation industry is developing the greatest army of fine mechanics the world has ever known! Everywhere in aviation... on famed assembly lines, teeming training schools, far-flung flying bases... Snap-on's superior speed, accuracy and durability have won outspoken preference.

SNAP-ON TOOLS CORPORATION, Kenosha, Wis.





WET CELLARS MADE DRY... *from the inside!*

If water or moisture seeps into your cellar through cracks or porous areas in the floor or walls, you can seal them permanently with Smooth-On No. 7. Applied with a brush to either wet or dry surfaces, this unique compound assures thorough water tightness . . . even in the wettest seasons. Smooth-On No. 7 is excellent for patching concrete floors, waterproofing garages, stables, washrooms, brick walls, cisterns, septic tanks, water troughs, fountains, fish ponds and swimming pools.



DO IT YOURSELF ... AT LOW COST

By waterproofing with Smooth-On No. 7 you will save a lot of money. It's easy to apply . . . all you do is mix with water and brush it on. 25 lbs. will cover about 100 sq. ft. of surface. Smooth-On No. 7 is sold in 1, 5, 25 and 100 lb. containers.

FREE INSTRUCTION BOOK SHOWS HOW

This handy 40-page repair book shows how to use Smooth-On No. 7 . . . and also tells you how to make hundreds of other money-saving, lasting repairs with other famous Smooth-On compounds. Everyone should have this practical guide on home, shop and auto repairs which shows how to stop leaks, seal cracks and tighten loose parts in metal, concrete, plaster and wood. It's FREE! Send for your copy today.



MAIL COUPON FOR *free* BOOK

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Jersey City, N. J.

Please send me the SMOOTH-ON Repair Handbook.

Name

Address

4-43

Do it with **SMOOTH-ON**

Keeping 'Em Flying

(Continued from page 11)

Philadelphia Quartermaster Depot rivals the navy establishment in size, though the army uses fewer flags in proportion to the number of men in the ranks. A tremendous amount of work goes into regimental standards and guidons, which, due to the danger of aerial observation, are left in the United States when troops sail. These regimental emblems are works of art requiring careful design, preliminary stenciling, retracing of complicated figures, and stitching or "painting with thread" which presents smooth work on both sides.

Particularly noticeable to a visitor in a flag factory is the fact that American flags are never permitted to touch the bare floor. Also obvious is that the manufacture of Old Glory is not just another day's work, but a task in which the experts take a genuine patriotic pride though they work in a sea of red, white and blue years on end.

Every war has produced a number of battle flags which have a special meaning to the nation. This war has already produced two and both are reverently guarded in glass cases in the museum at Annapolis, Md., the home of the U. S. Naval Academy.

One of these is the bomb-torn ensign of the U. S. Destroyer Shaw, one of the victims of Japanese treachery at Pearl Harbor. About half of the red and white area was torn away by the terrific blast which sank the ship, but when comparative quiet settled over the harbor the next morning, the flag was still flying on a mast which protruded above water. Navy men who have made a shrine of the glass case vow that it will fly again—on the topmast of the biggest Japanese battleship afloat.

Perhaps the fact that this flag survived and enabled the Shaw to come through with colors still flying had a special significance, for the Shaw was raised and refitted to fight against the Japs.

Nearby, in another case in the same museum, is the flag which flew over our naval base at Cavite. Brought back to the United States some months ago, it is a museum piece in the eyes of navy men for a limited time only. They say the day will come when the ensign will be rehoisted—at Cavite after the rising sun has set at this spot.

That's the spirit that will keep 'em flying.

OUTBOARD MOTORS GO *to War*



JOHNSON SEA-HORSES
for **DEPEND**ability

SOMEBODY ELSE is using your new Sea-Horse outboard motor. Somebody in America's armed forces.

He's not using it for fishin', either. He's giving it the gun on a dozen different jobs requiring guts—in engines as well as men.

It's not the first time Sea-Horses have served. Famous explorers who have ventured into the far reaches of the world know about Sea-Horse stamina. Men in the lumber and fishing industries are familiar with Sea-Horse power. Red Cross rescue squads, saving lives and administering relief in disastrous floods, have tested Sea-Horse ruggedness.

The Johnson Sea-Horse always has been noted for **DEPEND**ability. The fact that Sea-Horses were qualified for war work without any basic change in design, speaks volumes for their quality.

JOHNSON MOTORS, Waukegan, Ill.

In addition to outboard motors, we are building important precision items for the armed forces —devoting all our effort to the war.

HARLEY-DAVIDSON

for me after Victory



BUY WAR BONDS Now!

10% every pay-day will help Uncle Sam now — and help make you a Harley-Davidson owner when peace comes.

HARLEY-DAVIDSON

MOTORCYCLES

Out of the great experience gained in devoting our entire effort to the production of motorcycles that meet the grueling demands of war — will come the finer, more rugged and powerful Harley-Davidson of tomorrow. As always, it will be a world champion — a motorcycle red blooded Americans will be proud to own!

HARLEY-DAVIDSON MOTOR COMPANY
Department PM Milwaukee, Wisconsin

Our New Schools of War

(Continued from page 4)

the Allison engine plant, specializing in airplane equipment, has been furnishing, for months, training programs to a large number of United Nations air force depots and airfields. A student in the Allison school is taught to disassemble, overhaul, reassemble and time the engine. He is then taught the functions and overhauling of the accessories used in installations. Fuselages of all planes powered by the Allison engine have been set up for teaching installations, removal of engines, inspection, starting, warming up, ground tests, etc. Emphasis is placed on trouble shooting so that the trainee is thoroughly familiar with all phases of engine maintenance.

In the Oldsmobile gun school at Lansing, Mich., servicemen of practically every category are learning the servicing and operation of the cannon produced there. At the AC Spark Plug and Frigidaire plants of General Motors, machine guns are studied, and the courses include sound movies. One novel feature is the blindfolding of classes so that the men can learn to take apart and assemble these lethal weapons in the darkest night on a battlefield.

Six weeks will transform a mechanically minded recruit into an experienced overhaul mechanic handling Pratt and Whitney engines at the Buick college of war in Flint, Mich. Other classes study the same engine at the Chevrolet plant in Detroit and here special attention is given to the use of makeshift tools. It has been discovered that if an ingenious mechanic is deprived of all tools except a screwdriver he can make most of the necessary repairs and adjustments on the complex engine.

Classes of uniformed men at the Pontiac plant tackle two of the most complicated weapons in this war, the Oerlikon and Bofors guns.

Ford has an average of above 2,000 men constantly at its Rouge plant, most of them bluejackets acquiring the technical skill necessary for the operation of modern naval vessels. Uncle Sam is sending several hundred hand-picked flight mechanics to the Ford Willow Run plant for a post-graduate course in servicing the big Ford-built B-24 bombers. The men picked for duty with the B-24s will represent the top 20 percent of the graduating classes of Air Force training schools all over the country.

The mechanics go into camp just across the road from the big Willow Run plant. Barracks, mess halls and recreation facilities have been rushed to completion. Already skilled in their craft in the army schools, the mechanics will be given an intensive "finishing" course in the Ford school and plant. A crew will be ready for each bomber as it leaves the assembly line.

Most of the students at the Packard plant are navy recruits who specialize in the assembly, operation and repair of the motors for the deadly mosquito boats.

Not only do Army Air Force mechanics get mechanical training at United Air Lines Training Center at Oakland, Calif., but they are given intensive training in "Commando" tactics. At the call of "Air Raid!" the mechanics tumble out of hangars, shops and barracks, race to the nearby "Commando" course, scale a seven-foot wall, hurdle a fence, dive under a barbed wire entanglement, dart in and out through a maze of poles, race across a log spanning a deep pit. At the end, without stopping to take one restful breath, they spring to the task of getting airplanes under cover or ready to take off. It is all part of the job of preparing these men for alert, efficient action wherever they may be assigned. The theory is that an aviation mechanic is responsible for his airplane and, should it be threatened by enemy fire when on the ground, he must race to save it. He should be a superman as well as a technical expert.

About half of the servicemen who get production line training have had previous mechanical experience, working around automobiles, for example, but the other half includes men trained only as butchers, bus drivers, clerks, students or similar non-mechanical jobs. Before they are assigned for last-minute "college" education in the science of mechanical warfare, they have usually had mechanical courses offered by the army, and these have been preceded by tests which determine whether they have mechanical aptitude.

One thing is sure to result if the war continues long enough. This nation is going to lead the world by a widely increasing margin in mechanical manpower.

☛ To learn where to buy commercial products described in these pages, see the index.



ON Thursday the orders came in . . . 400 powerful outboards for immediate delivery to Lord Mountbatten's Commandos. All of them to be equipped with underwater mufflers. And all of them to be aboard an out-bound ship *on the following Monday!*

To meet the promise, there were neither motors enough nor parts enough at the factory. From dealer stocks extra motors were recruited to fill the requirement. Assembly lines were swiftly organized to build up new motors from spare parts. Army

officials gave unceasing cooperation to speed the job. Saturday night, loaded in express cars cut into a fast passenger train, the Commando's motors were on their way!

A small incident . . . in the vast dramatic panorama of America's Production-For-Victory. But a significant one to countless thousands of water-loving Americans. Again, their favorite motors are "in there pitching." And they can be confident that, where outboards can serve, no effort will be spared by Evinrude to produce *plenty enough, soon enough!*



EVINRUDE MOTORS
Milwaukee, Wisconsin

Evinrude Motors of Canada, Peterboro, Canada

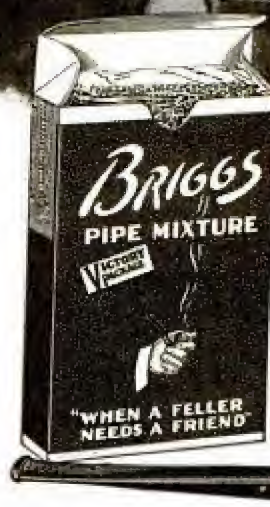
EVINRUDE
OUTBOARD MOTORS

★ Invest in America — Buy More Bonds

*Ah-h-h!...
that wonderful
BRIGGS!*



You'll get a boost—in pipe enjoyment—the minute you load up with Briggs. When the old briar starts giving out the grand richness of this tobacco that's been cask-mellowed for years (longer than many costly blends), you'll discover you're "that way" about Briggs. But who *wouldn't* go for such gloriously ripe flavor—such full-bodied mellowness—such relaxing fragrance! Better get started *today*.



BRIGGS

The Smoke with
a Smile



PRODUCT OF P. LORILLARD COMPANY

KRW ARBOR PRESSES BENCH TYPE AND HYDRAULIC

NEEDED IN EVERY SHOP—SAVE TIME AND MONEY—DO BETTER WORK, QUICKER.

No shop is complete without a small arbor press. Pressing and squeezing operations can be done better and faster on a KRW Arbor Press. Stop using vise and sledge hammer methods—they generally deliver spoiled work in the end. KRW Factory-To-You Prices give you greater value for your money. Order today.

KRW Bench Type Arbor Presses, 3 sizes

No. 37-P ½ Ton, \$13.25*
No. 37-O 1 Ton, \$23.00*
No. 37-N 3 Ton, \$33.00*

*Prices F.O.B. Arcade, N. Y. Slightly higher west of Rockies. Stand illustrated extra.



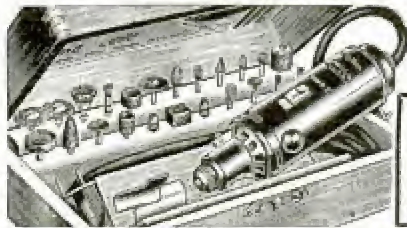
KRW Hydraulic Presses are built in 25, 50 and 75 ton sizes. Prices start at \$198.00*



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Builders of Shop Equipment for Ford Dealers Since 1916





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Kit No. 1 with 23 high grade accessories and Model 1 Moto-Tool in hard wood case \$17.50
Kit No. 2, same as above with Master Moto-Tool \$23.50

DREMEL MFG. CO., Dept. T-113-D, RACINE, WIS.

—Suggest—
MOTO-TOOLS
TO SAVE TIME—
CUT COSTS AND
SPEED PRODUCTION

\$100 MONTHLY FOR SICKNESS AND ACCIDENTS

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To \$1,000 If Killed!**

We have just issued a NEW sickness—accident—hospital policy that costs as little as 3c a day!

It pays up to \$100 a month for disability from sickness or accident—and hospital benefits in addition!

It pays your beneficiary up to \$1,000 if you are killed.

And most important—It covers ALL accidents from the very first day . . . ALL sickness from the very first day, except those specifically excluded in the policy. No waiting period of 7 or 14 days, as so many policies require.

It has other benefits—you will see them all for yourself when you send for a regular policy on FREE inspection without obligation. You can judge this important value for yourself!

Postal now is offering this protection, if desired, on a monthly payment plan of only \$1.00 a month—or on quarterly, semi-annual or annual payments.

BUT SEND NO MONEY. Write for policy on free inspection. No agents will call—no medical examination.

Don't delay—write today! Send full name, address, age, occupation, and name of beneficiary to Postal Life & Casualty Insurance Company, 5,001 Postal Life Building, Kansas City, Mo.

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* 1 to 9 H. P. Circulars on request. War limits production . . . We have repairs for all SHAW tractors sold in our 39 years in business. Write us for your needs.

YOU CAN BUILD YOUR OWN GARDEN TRACTOR

\$1.00 brings our plans, postpaid, telling how to build a garden tractor (Chiefly by welding and bolting up scrap steel), for cultivating, light plowing, etc.

SHAW MFG. CO., 4504 Front St., Galesburg, Kansas
666-G No. 4th St., Columbus, O.; 5812-G Magnolia Ave., Chicago, Ill.



NEW COMMANDO Military Style Shoes

Crash through to biggest shoe profits in years with sensational new soft-as-glove leather Military Shoes for Men of Action—also hundreds of other fast-selling styles for men and women, for dress, work, sport. Rush name and address for FREE SAMPLE OUTFIT, and Tested Sales Plans.

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FREE SALES KIT

REVIVES RIBBONS FOR 1/2 CENT

In a few seconds Sten-O-Aide makes old faded office machine ribbons work like new. Use them 3 to 5 times longer. Kit pays for itself in short time. Every typewriter owner needs one. Satisfied users everywhere. Money-back-guarantee. Write today for Free Folder.

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4671 So. Division Grand Rapids, Michigan

NEW Grinding Attachment

For 8" to 16" Metal Lathes. Build It Yourself.

At last, a precision grinder within your means. You save 2/3 by finishing out semi-machined castings, on your own lathe. HURON handles both external and internal grinding. Accuracy to .00025". Mirror finish easily obtained. Grinds valves, pistons, bushings, shafts, hard or soft, holes, lathe centers, Sharpeners, reamers, milling cutters. Does necessary dressing; sharpens, polishes; scores of other uses, for home workshop, stores, machine shops. Write for FREE Illustrated folder and price list of supplementary items. Mention your lathe.

Huron Machine & Tool Co., Dept. B, Yale, Mich.



Semi-Machined Castings
Only \$6.45

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WANT a permanent business profession of your own? Then BECOME A FOOT CORRECTIONIST. Earnings in this greatly needed profession run as

high as \$50-\$100 weekly after a few weeks home training—no medical or chiropody—no further capital needed, no goods to buy. 47th year. Write for free booklet.

Stephenson System of Foot Correction

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LEARN the SECRET of INDIAN COMFORT FREE



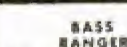
BASS SPORTOCASINS
Royal road to perfect comfort.



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The favorite national leisure footwear.



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Here's foot comfort supreme for men who love the great outdoors!



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FREE booklet showing all styles of men's and women's outdoor footwear. Explains Indian-comfort construction. Mail postcard today. G. H. Bass & Co., 64 Main St., Wilton, Maine.

WEAR BASS MOCCASINS

Running the Ice Blockade

(Continued from page 53)

plenty of power and streamlined hull design. This combination was first utilized in small tugs like the wooden Algoma, an early lake ice breaker. Most tug boats have an egg-shaped hull which keeps them from sticking as they advance in ice packs, and enables them to reverse easily. But they lack the weight and size to tackle ice under heavy conditions or to break a single channel wide enough for a cargo ship. Tugs are most effectively used to keep previously cut channels open by breaking up floating pieces of ice and working against the sides of the channel.

They often work tandem ahead of a line of freighters, the first to clear the channel of ice that has slipped in from the sides, the second to widen the channel or tow the first freighter through slush ice. This avoids the situation where a towing tug might get stuck breaking a path and be run down by its tow. Once under way a line of loaded freighters can make steady progress through slush ice behind a breaker.

Mainstays of the initial attack on Old Man Winter are the Coast Guard's 165-foot ice-breaking cutters and car ferries, such as the Wawatan and Sainte Marie. Their greater weight, strength and beam enables them to cut a channel of sufficient width that cargo vessels may follow them through soft or "rotted" stretches. If a single breaker has to cut a channel alone in waters which have a swift current, she will begin downstream so that the current washes broken ice clear of her stern. To speed up operations and to free some vessels for other wartime activities, the Coast Guard charts additional tugs and ferry boats. Champ of the tugs is the Favorite, which often breaks ice with her stern piled high with coal. This provides extra fuel and helps raise the bow much as water ballast is used on other ships for the same purpose.

The car ferry Sainte Marie is one of the best all-around ice breakers on the Lakes. She is 258 feet long with a 62-foot beam, has a propeller both fore and aft. Her deck is square at both ends, her spoon-shaped prow reinforced at stem and forward ribs.

Similar, but longer, is the ferry "Chief Wawatan." Less maneuverable, the Wawatan cuts a straighter course in heavy ice.

(Continued to page 174)

how to **STRETCH** your "A" Coupons!



Make the most of your "A" coupons. Get better gas mileage by restoring compression, improving combustion and sealing leaks through Burd 3-Way Reconditioning Service. 1. Have Burd "Graf-Flox" Piston rings installed. They are self-lubricating; require no run-in period. 2. Stop piston slap and restore flexibility with Burd Piston Expanders. 3. Keep oil out of intake chamber and prevent carbon with Burd Valve Packing. Have all three jobs done at once at practically no extra cost for labor. For greater wartime economy . . . ask your garage-man for Burd 3-Way Reconditioning Service.

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RECONDITIONING
SERVICE

Burd Piston Ring Co.,
Rockford, Ill.,
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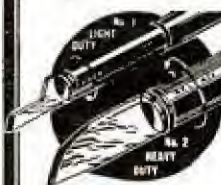
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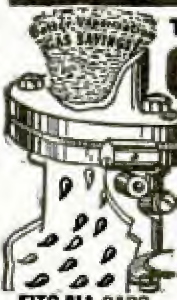
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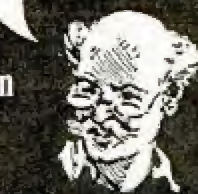
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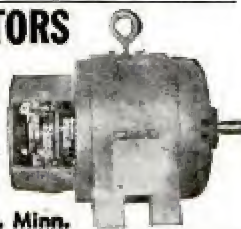
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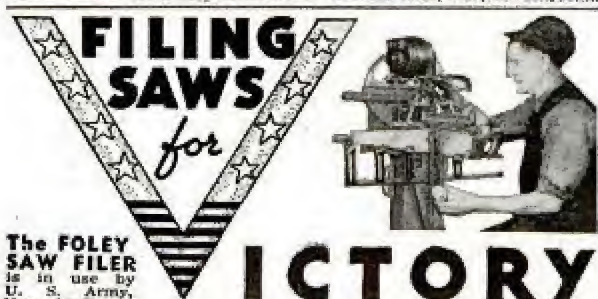
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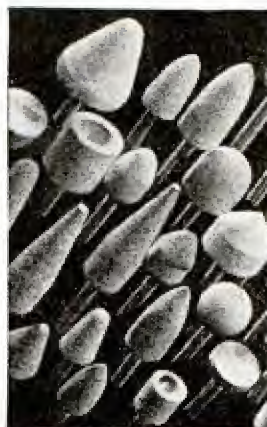
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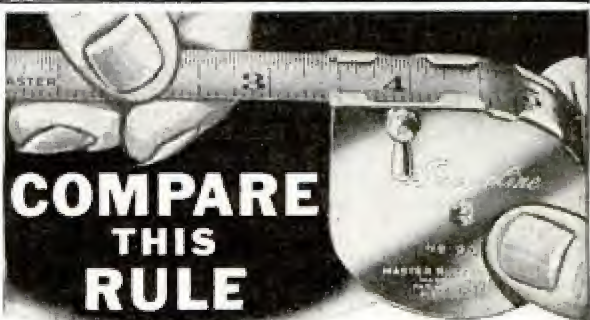
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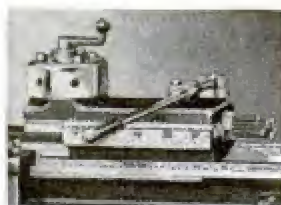
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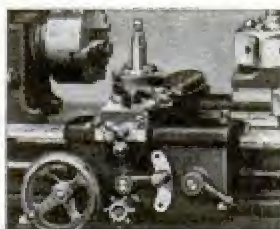
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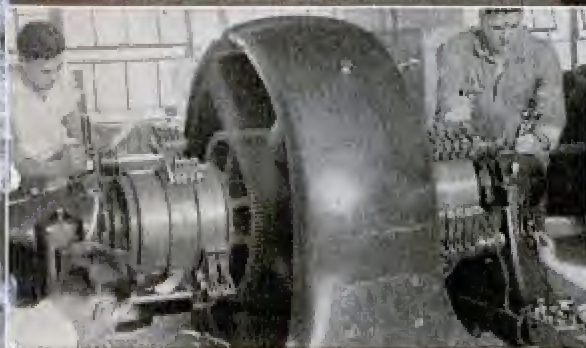


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